Electrical Review

Vol. 77—No. 16. CHICAGO, OCTOBER 16, 1920. Page 589.

The Overhead Line Considered as a Mechanical Structure

Seventh of a Series* of Articles Giving a Review of the Electric Power Situation — Calculating Mechanical Stresses in Transmission Lines — Effect of Temperature — Other Considerations

By ALFRED STILL

When wires are strung between poles or towers to serve as conductors for electric currents there are two questions with which the engineer is chiefly concerned: (1) Are they strong enough to withstand the mechanical stresses likely to be imposed upon them by high winds, ice deposits and changes of temperature; (2) are they sufficiently well insulated from each other and from the supporting structures themselves to carry the high-voltage currents which are necessary to transmit large amounts of energy over considerable distances?

*Preceding articles in this series appeared in the July 17, Aug. 7, Aug. 21, Sept. 4, Sept. 18 and Oct. 2 issues of Electrical Review.

In this article an attempt will be made to indicate the nature of the problems to be solved, in order that a reasonable degree of safety may be assured against rupture or overstressing due to abnormal loads. The electrical problems will be discussed in another article. Practical formulas will not be developed, and the methods used for calculating stresses in overhead wires will not be discussed. The fundamental principles will be explained and the various factors in the problem will be referred to, the object being to give the reader, in the simplest manner possible, an accurate idea of the nature and magnitude of the mechanical engineering problems to be solved by the engineer when designing the various span

Fig 1.—Machine for Stranding Conductors for Transmission Lines.

sections of an overhead electric power transmission line.

Consider a mass of any irregular shape, the weight of which may be represented by the vertical vector OP_G passing through its center of gravity O' as shown in Fig. 2. This mass is suspended by two perfectly flexible ties from the

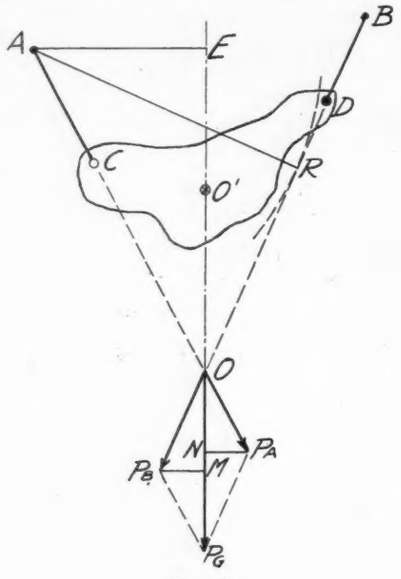


Fig. 2.

fixed points A and B. Except for the special case of parallel forces, the resultant P_G and the components P_A and P_B acting in the direction of the suspension cords, AC and BD, will pass through the common point O. The system of forces is in equilibrium and the conditions to be fulfilled are, therefore: (1) that the vectorial sum of all forces and reactions shall be zero, and (2) that the sum of all moments taken about any point shall be zero.

The following is an explanation of the manner in which a force diagram similar to Fig. 2 may be constructed.

The known data are:

1. The position of suspension points A and B.
2. The magnitude and position relatively to points A and B of the force of gravity, i. e., the length of the vector OP_G and the distance AE of this vector from the point A.
3. The magnitude, but not the direction, of the force P_B acting through the suspension point B.

The required data are:

1. The direction of the force P_B.
2. The magnitude and direction of the force P_A.
3. The horizontal and vertical components of the forces at the points of support.

Taking moments about the point A gives the equation:

$$P_B \times AR = P_G \times AE$$

thus

$$AR = AE \times \frac{P_G}{P_B}$$

From the point A as a center use this radius to draw an arc of a circle, the tangent to which, passing through B, will locate the point O. Draw OP_G to the proper scale to represent the force of gravity, and complete the parallelogram of forces. The vertical component of the reaction at point A is NO, and at the point B it is MO. The horizontal reactions at the points of support are P_AN and P_BM respectively. These are obviously equal, but opposite in direction, in every conceivable case of a body in equilibrium subject only to the force of gravity acting, as it always does, vertically downward.

By applying these fundamental principles of graphical statics to the case of a wire strung between two rigid supports and acted upon by the force of gravity, the shape taken up by a suspended wire and the tension in the wire at any point may be calculated. Fig. 3 shows a wire suspended between the two points A and B in the same horizontal plane. If the maximum sag or deflection (the distance ND in Fig. 3) is small relatively to the span (the distance AB), no serious error is introduced by assuming the weight of the wire to be distributed uniformly along the horizontal line ANB. This assumption will cause the curve ADB to be the arc of a parabola. If the sag is very great, as for instance when a wire is strung from towers on opposite ridges across a valley which might be as much as a mile wide, the proper assumption to make is that the weight of the wire is distributed uniformly along the length of the wire and not along a straight line joining the two points of support. If the further assumption (not always justifiable) is then made that the wire or cable is of infinite flexibility, the curve ADB of Fig. 3 would be a catenary.

On very long spans, even with fairly large conductors, the actual curves assumed by the wires hanging in still air under the influence of their own weight only will approximate more nearly to the catenary than to the parabola, and if it is desired to introduce refinement of calculation the catenary is the more correct curve to work to on long spans. Owing to the many more or less arbitrary assumptions that must necessarily be made in all calculations on the mechanical features of a transmission line, such refinements are

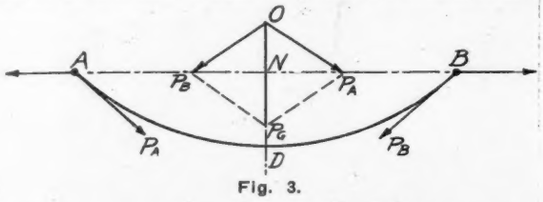


Fig. 3.

usually unnecessary and only justifiable when they involve no additional time or labor in the calculations.

In Fig. 3, a wire weighing w lb. per ft. is stretched between the supports A and B lying in the same horizontal plane. The maximum tension in the wire is P_B lbs. This is the tension at the points of support, and, owing to the symmetry of the figure, it is the same in amount at A as at B. The assumption is now made that the total weight of wire is equal to the weight per foot multiplied by the straight line distance between the points A and B. Thus

$$P = w \times l$$

where l is the distance in feet between A and B.

Draw the vector OP_G to represent the total downward force wl. It will lie on a vertical line midway between A and B. Let it be bisected by any horizontal line such as AB. From O lay off OP_B at such an angle that the head P_B of the vector lies on the horizontal line bisecting OP_G. Complete the parallelogram of forces. Then ON represents the vertical component of each point of support, and NP_B or NP_A is the horizontal force P_h acting at each support; it is also the total tension in the wire at the center or lowest point of the span.

Referring to Fig. 4, which shows a span of length l, we can now calculate the sag s at the center. Consider the moments about the point A due to the half span AD. These must balance, and the equation is

$$s \times P_h = \frac{l}{4} \times \frac{wl}{2}$$

whence

$$s = wl^2/8P_h$$

which is the well-known formula for sag calculations when the parabolic assumption is made.

Given an overhead conductor hanging in still air from supports at the same level, under the influence of its own weight only, the tension in the wire at the center of the span will therefore be $P_h = wl^2/8s$, and in practical work, except on exceptionally long spans, the maximum tension in the wire will be so nearly equal to the horizontal component of the pull that the tension at the points of support (where the maximum pull occurs) may be assumed the same as the horizontal component as calculated by the latter formula.

Sufficient has been said to show how the calculations may be made and how the formulas used for calculating stresses in transmission wires may be developed. When the supports A and B are not in the same plane the problem is just as simply solved and the stresses in a line on a steep grade may be predetermined within any desired degree of accuracy.

Effect of Wind and Ice Deposits on Overhead Wires.

The effect of snow and sleet adhering to the wires and so forming an ice coating is to increase the amount of the dead loading. It is customary to assume a cylindrical deposit of ice distributed uniformly over the whole length of span, the result being that strength and deflection calculations may be made by taking the weight of wire plus ice at, say, w_1 lbs. per ft. instead of w lbs. per ft., which would be correct if the wire were not carrying the additional ice load.

What is usually of more importance than the ice load is the effect of strong winds blowing across the wires at right angles to the direction

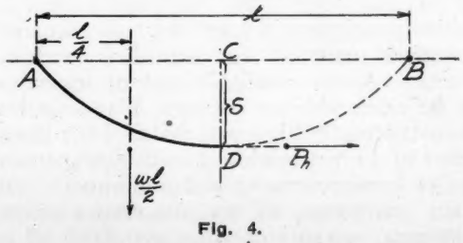


Fig. 4.

of the line. Obviously, the effect of such winds on a wire of which the diameter has been appreciably increased by the formation of an ice coating is likely to be of much greater importance than even stronger winds blowing across the bare wires. It is, indeed, the combination of heavy sleet formations and strong winds occurring at low temperatures which causes more damage than other accidents to which overhead lines are subject.

It is usual to assume that the wind pressure acts in a horizontal direction and that the total load on a conductor is the resultant of two forces, one acting vertically downward due to weight of

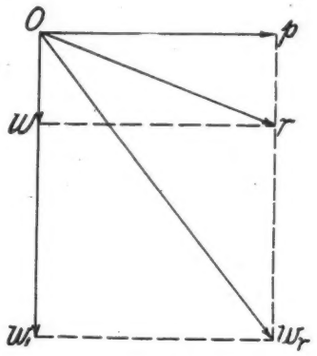


Fig. 5.

wire together with added weight of sleet or ice (if any) and one acting horizontally due to the wind pressure. These forces are indicated in Fig. 5, where Op represents the wind pressure, Ow the weight of the conductor, and ww_1 the added weight of ice. The resultant pressure Ow_r is equal to $\sqrt{p^2 + w^2_1}$. If the line runs through a country where sleet does not form on the wires the maximum resultant pressure is Or instead of Ow_r if the assumed maximum force due to wind is the same in both cases.

In order to calculate the maximum deflections and tensions of wires likely to result from such climatic conditions as may be expected, it is necessary merely to substitute in the formulas the value Ow which is merely the weight per foot of the conductor without any additional loading due to wind or ice or a combination of both.

Probable Magnitude of Ice and Wind Loads on Transmission Lines.

A careful study should be made of the weather conditions, including temperature range and probable wind velocities in the locality through which an overhead line is to pass. The information thus gained must then be used to determine the maximum loading which the wires should be capable of withstanding without being strained beyond the elastic limit (about half the breaking stress).

Sleet and snow may form ice deposits 3 and 4 ins. in diameter. Under exceptional circumstances a deposit 6 ins. in diameter has been observed by the Central Colorado Power Co. on some of its steel conductors used where the length of span and the weather conditions have led to the substitution of this material for copper or aluminum. It is, however, very rare to find

deposits of which the thickness exceeds 0.75 in. A very common assumption on which calculations are based is that the ice coating will not be more than 0.5 in. thick. The weight of the ice coating is usually taken at 57.3 lbs. per cu. ft., and it is an easy matter to calculate the additional dead load per foot of wire for any thickness of ice deposit.

The pressure exerted by wind will depend upon its velocity and also on the barometric pressure. The correction for barometric pressure is usually not worth making except in the case of lines erected at very high altitudes. H. W. Buck's formula is

$$F = 0.0025\,V$$

where F is the pressure per square foot of the projected surface of a cylindrical wire, and V is the actual wind velocity in miles per hour. The projected area is of course found by multiplying diameter by length. When the conductor is coated with ice the diameter of the ice-coated wire must be used in the calculations of wind pressure.

Three classes of loading are usually considered, the choice depending upon the district through which the line will run. The first would be chosen where it is known that sleet deposits do not occur.

(A) Vertical load consisting of weight of wire only; horizontal load, 15 lbs. per sq. ft. of projected area of wire.

(B) Vertical load, dead weight plus 0.5 in. coating of ice; horizontal load, 8 lbs. per sq. ft. of projected area of coated wire.

(C) Vertical load, dead weight plus 0.75 in. ice; horizontal load, 11 lbs. per sq. ft.

The actual wind velocities corresponding to the pressures here mentioned as calculated by Mr. Buck's formula are 77, 56 and 66 mi. per hr. respectively for the three loadings, A, B and C.

F. F. Fowle has made many observations on wind velocities in Chicago. He finds that the wind velocity rarely exceeds 50 miles, the maximum recorded during a period of 36 years being 84. Wind velocities of 90 mi. per hr. have been recorded in Buffalo. The combination of strong winds and very low temperatures is uncommon. Wind velocities of 53, and on one occasion 60 mi., have been recorded during sleet storms, but Mr. Fowle is of opinion that it is rarely necessary to allow for wind velocities greater than 47 mi. per hr. for steel tower lines, and 40 mi. per hr. for wood pole lines. The reason for the higher figure on the steel tower lines is because wind velocities are greater at an elevation of 50 to 100 ft. above ground level than they are at a height of 20 to 40 ft.

Effect of Temperature Variations on Wire Sags and Tensions.

A factor of safety of two is customary in stress calculations on overhead wires. This will permit of copper conductors being stressed up the elastic limit, which is about half the breaking stress. In England, where a factor of safety as high as five has been insisted upon, it cannot be said that anything has been gained in the matters of continuity of service or safety to life, because this and similar regulations issued by the governing authorities have had the effect of discouraging the construction of overhead lines of any importance.

It is a very simple matter to calculate by means of formula $P_h = wl^2/8s$ the sag corresponding to a given length of span and whatever may be decdied upon as a maximum safe value for the tension in the wire. The safe minimum sag for the maximum tension when the wire is subjected to the greatest expected load in the matter of ice and wind pressure may thus be determined. This minimum sag will occur at the lowest temperature to be expected in the district through which the line is to be carried.

Another formula is used for calculating the length of wire in the span. When the sag is relatively small, and the curve taken by the wire is assumed to be a parabola, this formula may be written:

$$\text{Length of wire} = l + (8s/31)$$

The calculation of the sags and corresponding tensions at temperatures and under conditions of loading other than those which will cause the tension to be a maximum is not by any means a simple matter. A decrease of tension will cause a wire to contract in length because of its elastic properties, while an increase in temperature will cause it to become larger. If the extra load on the conductor due to wind pressure and ice (if any) be removed, the sag will adjust itself until the formula $P_h = wl^2/8s$ is again satisfied, the weight w being, in this case, that of the wire only. It must be noted, however, that the length of the wire, as expressed by the latter formula, will now be equal to the length as originally calculated for the loaded wire, less the elastic contraction due to the reduction of tension. If the temperature be now supposed to rise the length of the wire will increase, but not in direct proportion to the temperature increase, because, so soon as there is any increase in length leading to an increased sag, the tension in the wire is immediately relieved, and, since it is assumed that the elastic limit has not been exceeded, there will be a reduction in length which could easily be calculated if the amount by which the tension is reduced were known.

Mathematical formulas for the solution of this problem involve the first and third power of the unknown quantity and are awkward to handle. Graphical methods and some analytical methods, or a combination of both, will yield good results and each engineer will have a preference for the method which, in his hands, will solve the problem in the shortest time. It is not proposed to go further into these matters of sag and tension calculations because in stating the problem and indicating the factors entering in its solution the purpose of this article has been accomplished.

Comparison of Properties of Materials Used for Conductors.

Although copper is used in greater quantities than other materials for overhead conductors, aluminum is also available and in many cases may be preferable to copper. Under ordinary circumstances, the choice of material for the conductors of an overhead high-tension transmission line lies between copper and aluminum. Under certain conditions, as for the transmission of continuous currents or when the price of more

suitable materials is abnormally high, galvanized iron or steel may prove satisfactory and economical; and compound wires or cables such as copper-clad steel and aluminum cables with galvanized steel core are used where great mechanical strength is needed in combination with wire of high conductivity.

It is probably safe to assert that, apart from the question of cost, the high conductivity combined with the great strength and elasticity of **hard-drawn copper** give this material the advantage over others for use on the average high-tension electric transmission line. The breaking stress of copper wire of the sizes used in stranded conductors is from 60,000 to 65,000 lbs. per sq. in.

The conductivity of hard-drawn aluminum wire is between 60 and 61.5% by Matthiessen's standard, pure copper being 100%. The weight of an aluminum conductor is almost exactly half that of the copper conductor of equal resistance, and it is about 77% as strong as the equivalent copper cable (safe working stress). Comparing aluminum of 61% conductivity with copper of 97% conductivity, the diameter of the equivalent aluminum cable would be 1.26 times the diameter of the copper cable,

The ultimate tensile stress of hard-drawn aluminum wire usually lies between 24,000 and 32,000 lbs. per sq. in., depending upon the size of wire and hardness; if carried beyond a certain point, high tensile strength is a disadvantage, because the conductivity is lowered and the wire becomes "short."

The ordinary commercial galvanized steel strand cable, as used for guy wires, has a breaking strength averaging 70,000 lbs. per sq. in., and a conductivity of about 11.5% by Matthiessen's scale. When used to convey alternating currents, the high permeability of iron increases the so-called skin effect, with the result that the resistance to the flow of current may be greatly increased, depending upon the size of the cable and the frequency. Apart from the greater loss of voltage due to apparent increase of resistance when iron wires are used with alternating currents, the loss of pressure due to increased reactance must also be taken into account. The external reactance is the same for a given diameter and spacing of wires whatever may be the material; but the internal reactance will obviously be much greater for a "magnetic" than for a "non-magnetic" conductor. When comparing iron with copper or aluminum as a possible material for conductors, the shorter "life" of the iron wire must not be overlooked.

The weight of an iron or steel cable will be at least five times that of the copper cable of equal resistance, and with the higher grade (and stronger) steels, this multiplier may be as high as ten. High-grade steel conductors can be used to advantage for very long spans or where the climatic conditions are such as to subject the cables to abnormally great stresses. Extra high strength steel wire can be obtained with an ultimate strength of 180,000 lbs. per sq. in. and an elastic limit of 110,000 lbs. per sq. in. A possible maximum working stress for this material would be about 80,000 lbs. per sq. in.

By welding a coating of copper on a steel wire a compound wire known as hard-drawn copper-clad steel wire is produced. This has been well tested, and experience has shown it to be an excellent material for many purposes. The wire can be made up in the form of cables if desired, which, when used as conductors for overhead transmission, will have greater strength than cables made entirely of copper, and much lower resistance than cables made entirely of steel. The two metals are intimately and permanently welded together by means of a special copper-iron alloy, and the relative quantities so adjusted that the finished wire has a conductivity of 30% of a copper wire of the same diameter.

The central wire of a stranded conductor may be galvanized steel, or a small diameter steel cable may be used for the core. This increases the strength, especially in the case of aluminum cables, and a compound conductor of this sort is useful for long spans on an aluminum-wire transmission line. It is usual to neglect the current-carrying capacity of the steel core, and calculate the conductivity on the assumption that all the current is carried by the strands of the higher conductivity metal. Composite cables can be made of steel and copper wires, but the strength of hard-drawn copper is so great that the gain due to the addition of the steel core is comparatively small.

When a stranded conductor is made up of one material only, the central wire is subjected to a greater strain than the wires that are spiralled around it. This difficulty can be overcome by using hemp for the central core. A hemp-core cable will have slightly greater diameter for the same conductivity and greater smoothness of surface than a metal-core cable, and these features will raise the critical voltage at which corona will form.

Although solid conductors may be used when the amount of current is not very great, stranded cables are generally to be preferred. The pitch (of each wire) in a standard concentric-lay copper wire conductor is usually between 12 and 16 diameters of the finished cable. The tensile strength of a stranded conductor is about 90% of the total strength of all the wires forming the cable. The illustration (Fig. 1) from a photograph supplied by the Rome Wire Co., shows a large stranding machine as used for combining the individual wires to form the finished cable.

Determining the Length of Spans on Overhead Transmission Lines.

From the relations indicated by the formulas developed in the earlier portions of this article, it is obvious that an increase in the distance between supporting structures necessitates higher towers to take care of the greatly increased sag which must be provided if the tension in the wires is not to become excessive. The saving in the number of supports and of insulators must therefore be set against the increased cost of the higher and stronger towers required on the longer spans. The determination of the best span to use is an economic problem—there are few engineering problems which are not fundamentally economic—and its solution is not very difficult. Pole-line spans range from 200 ft. with wood poles to 400 ft. or more with the latticed steel

poles; while the steel-tower lines, as generally used for the higher voltages, have spans ranging from 600 to 850 ft. Exceptionally long spans may be used where the natural formation of the ground necessitates or permits of the use of a considerable length of unsupported wire. Very high towers are sometimes required in order that the wires, even at the lowest point in the span, shall clear shipping on navigable rivers. The largest span in the world crosses the St. Lawrence river about 20 mi. from Three Rivers, Quebec, and is 4800 ft. in length. The steel towers to which the conductors are anchored are 350 ft. high. The longest span in the United States is on one of the transmission lines of the Pacific Gas & Electric Co. where it crosses the Carquinez straits. The distance between points of support is 4427 ft., and steel conductors are used.

There are no engineering difficulties in the way of using still longer spans, provided the natural formation of the ground is favorable. With very long spans the sag of the wires must necessarily be very great and advantage must be taken of hill-tops to obtain the required height at the points of support. Even without any additional loading such as will be caused by wind pressure and ice deposits, a limit is reached where the wire will no longer carry its own weight. Calculations, which are easily made, show that the safe stress in the material—the elastic limit—is reached with steel cables when the span is about 4 mi. For aluminum the maximum would be 3 mi., and for copper somewhere between 2.5 and 2.75 mi. Obviously the length of no single span on a practical transmission line can ever attain these limiting figures.

Methods of Making Joints and Ties for Conductors.

Joints in conductors can and should be made to be of the same strength as the wire itself. It cannot be said that there is any one method which has proved itself superior to all others. The McIntyre joint is one which employs a soft tube of the same material as the wires. This tube incloses the overlapping ends to be joined and is then twisted. It is claimed that when the sleeve

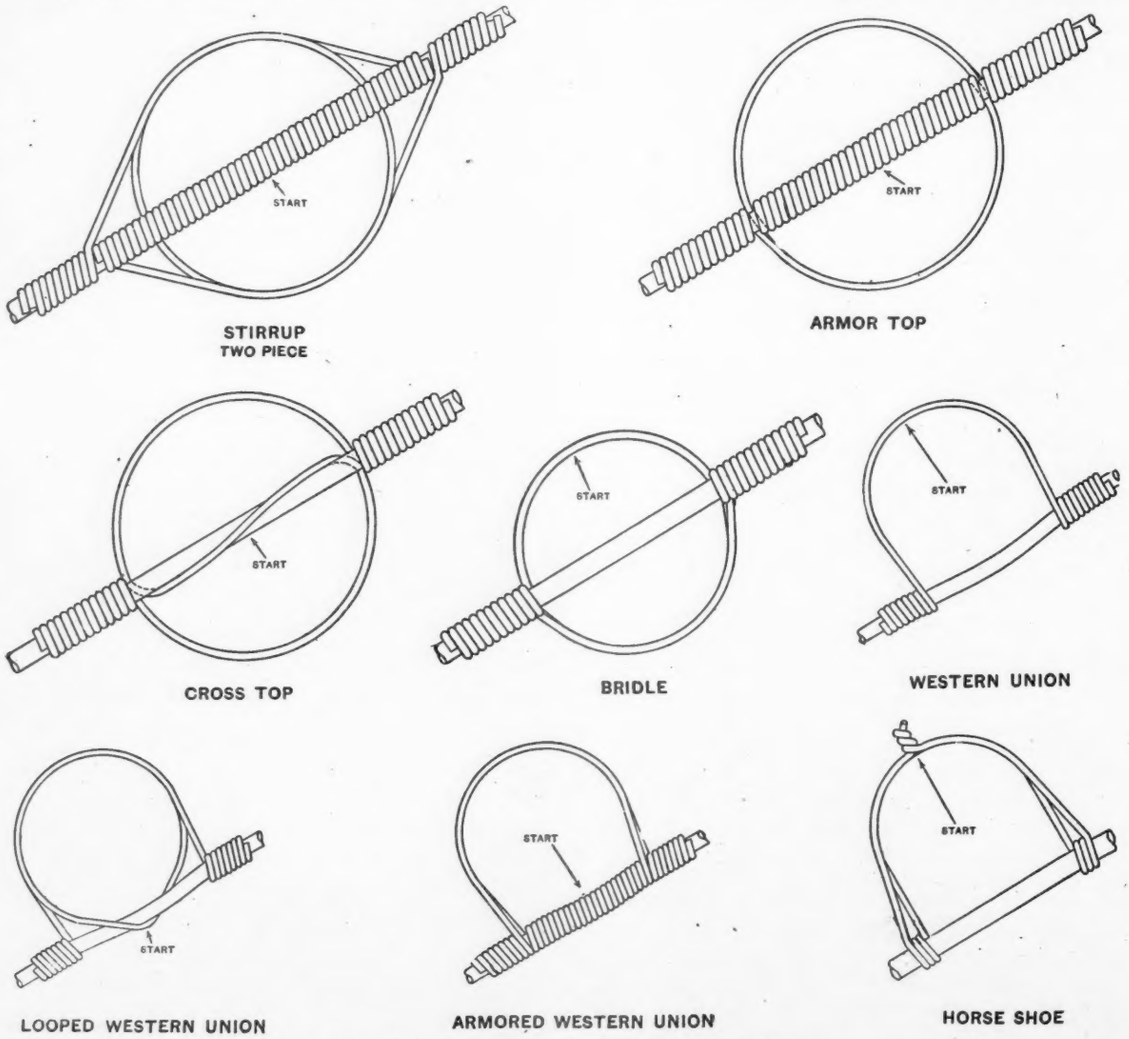


Fig. 6.—Methods of Tying Line Wire to Insulators.

The illustrations are plan views with insulators removed to show details. No. 4 tie wire should be used for No. 1 and smaller conductors, and No. 2 for No. 0 and larger conductors. The same metal as that of the conductor should be used for the tie wire, the tie wire being soft drawn to wrap tightly around the conductor. The conductor should be placed in the top groove of the insulator where possible. Lengths of the wires vary from 3 ft. for a single tie on a small insulator to 25 ft. for such as a stirrup tie on a 50,000-volt insulator. For combined security and economy of tie wire the cross-top tie is excellent.

is long enough to allow of three complete turns, the strength of this type of joint is equal to that of the cable itself.

Tie wires usually secure the conductor to the insulator in such a way as to prevent as far as possible the creeping of the conductor from one span to another. In some cases, however, it is advisable to allow the conductor to slip, or the tie wire to break, before the tension in the cable is great enough to damage insulator or crossarm. Soft or semi-hard wire is generally used for ties, and the size should not be less than No. 4 B. & S. copper, or No. 2 B. & S. aluminum. The tie wire should be of the same material as the conductor.

Some forms of tie include a serving of the tie wire extending an appreciable distance on each side of the insulator, the object being to afford some protection to the conductor in the event of an arc striking over the insulator.

A long sleeve over line wires at point of support is objectionable. It is true that breakages of wires caused by too great rigidity at points of support are of rare occurrence; but where mechanical forms of cable clamps are used, as with the suspension type of insulator, and in many of the larger pin-type insulators, the method of clamping the conductor to avoid mechanical injury or weakening due to vibration or to swaying of the wires in a wind should receive careful attention. The latest developments in the matter of mechanical clamping devices for line wires show that attention is being paid to the minutest details tending toward sound construction and durability.

EVIDENCE THAT ELECTRICAL INDUSTRY IS BOOMING.

Western Electric Co.'s Business in Last Eight Months Indicate Volume of $225,000,000 for Current Year.

The continuing activity and prosperity of the electrical industry is evidenced by the volume of business reported by the Western Electric Co., whose sales are running at a higher rate than at any other period in the company's history. For eight months of the current year its domestic billings showed a total volume of $119,500,000, indicating domestic sales for the year of approximately $190,000,000. This does not include its export business or sales of its foreign affiliated companies, which will probably reach a volume of $38,000,000, bringing the total business up to more than $225,000,000 for the year. The domestic sales will exceed the 1919 business by over $60,000,000, and are greatly in excess of the company's largest previous year, that of 1917. This is especially worthy of note when it is considered that in 1917 the sales were materially affected by the heavy buying of the United States government, while in the present year the business is in all lines of the company's activities and in all sections of the country. This is true not only with respect to telephone apparatus, but is especially marked in such labor-saving devices as washing machines, sewing machines, vacuum cleaners and also in farm power and light plants.

That the enlarging demand is not of a temporary character is indicated by the recent increase of unfilled orders on the company's books from $47,400,000 on Jan. 1 to over $85,000,000 on Sept. 1, deliveries in many instances being scheduled for 1921 and 1922.

The company's officials state that the sales would have been much larger had it not been for difficulties experienced in the supply of raw materials, delays in transportation and shortage of labor. The company's manufacturing plant at Hawthorne, Ill., has been greatly enlarged and further additions are now being made to it. The number of employes on Aug. 31 was 33,231, the greatest in the history of the company.

The export and foreign business is also expanding steadily. The New York office has recently announced the organization of a new company in the Argentine to take care of the telephone requirements of the countries in the southern part of South America. The Canadian branches have substantially increased the volume of their business over previous years. The company's factories in Antwerp and London are both running to full capacity, the London factory turning out a larger volume of material than in the pre-war days. The Antwerp factory, which was in control of the Germans during the war and has since had to be completely rehabilitated, is now gaining rapidly and should reach the pre-war rate of production by the end of the year. The Italian business has lately suffered, in common with other Italian industries, by reason of the labor troubles, but these seem to be in process of satisfactory adjustment. A separate company has recently been organized in Norway to care for the increasing Scandinavian business. The branches in Australia, Japan and China are all running at a satisfactory rate.

While the company's business in this country and in its many foreign branches throughout the world has expanded considerably in 1920, the present indications are for still further growth

WATER POWER OF MACEDONIA TO BE EXPLOITED.

Greek capitalists are reported to be investigating the water-power resources of Macedonia. It is estimated that an expenditure of 500,000,000 francs (approximately $100,000,000 at normal rate of exchange) will be necessary to utilize the estimated 340,000 hp. One-seventh of the electrical current generated will be used for the Saloniki district, while the rest will be conducted to Athens. Energy is to be diverted on the way to Athens for utilization in new mining and agricultural operations.

FIXTURE LABEL IDENTIFIES NATIONAL COUNCIL'S PRODUCTS.

The National Council of Lighting Fixture Manufacturers has recently issued to dealers through its members a neatly designed label for use on products as orders are filled. This label was adopted and is being used in accord with an understanding between the executive board of the National Dealers' organization and the executive committee of the National Council of Lighting Fixture Manufacturers.

Ultimate Boiler Capacity Limited by Design and Operation*

Size and Shape of Gas Passages, Superheaters, Dry Pipes, Boiler Nozzles and Feed Pipes Are Limiting Factors—Heat Head Determines Rate of Heat Transfer—Theoretical and Practical Ideas

By JOSEPH HARRINGTON

Vice-President and Engineer, James A. Brady Foundry Co., Chicago.

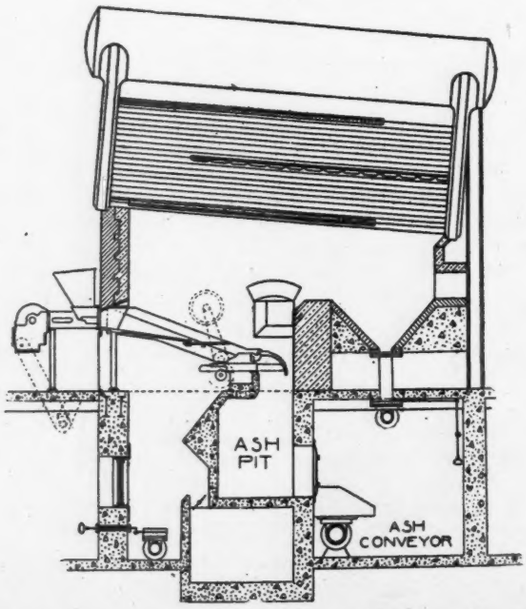
Coal is the most valuable commodity handled by man. In using the word "valuable," the meaning of having the greatest importance among our essentials of life is implied. Almost without exception, every activity of mankind is directly affected by power in some form or other—which power is, in almost all instances, derived from the burning of coal. It would be difficult indeed to underestimate the importance of coal. The old saying "We never miss the water till the well runs dry" applies to coal with almost equal emphasis.

The coming winter promises to be one to be remembered in this particular, and anything carrying with it a scrap of enlightenment as to how the burden can be lightened is worth the time and trouble of anyone to develop. With the admitted necessity of power generation, let us discuss without too much technicality some of the things affecting the power plant of today.

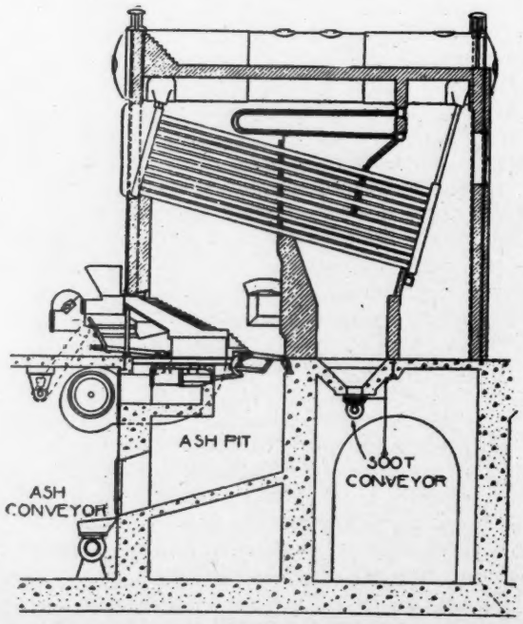
As a practical phase of the subject, it must be recognized that the details of power generation are governed by the same laws that control all business. Power must be generated and sold at a cost which will leave a sufficient profit for the encouragement of capital and the development of personal interest. Enormous increases in the costs of power-plant equipment have thrown a burden upon the central-station company which only those actively engaged in the management of such enterprises can fully appreciate. Fortunate it is that there are some mitigating circumstances. It would be disastrous indeed if plant capacities had to remain where they were five or six years ago. It was thought then that a boiler developing twice its rated capacity was being worked about up to the limit, but today an output of 300% is not abnormal and 400% is no farther away today than 300% was a short time ago. A study of the limitations imposed by the fuel will be discussed later, consideration being now confined to the boiler proper.

The tendency being to get the maximum out of a given boiler investment, the question naturally arises "How far can we go?". Ordinarily, this phase of the question would be subdivided into two parts, as determined by physical considerations on the one hand and economic considerations on the other. It is generally, if not universally, admitted that a clean boiler tube cannot

*First of a series of articles by Mr. Harrington, assisted by W. A. Nelson, advisory engineer of the James A. Brady Foundry Co., dealing with the present fuel situation from a combustion standpoint. Features of furnace and stoker construction and operation, and utilization of low-grade fuels, as related to ultimate boiler capacity, will be taken up in later articles.



Boiler Having Long Gas Passage Parallel to Direction of Tubes.



Boiler Layout With Inclined Tubes and Vertical Gas Passages.

be burned provided there is an adequate flow of water over the side opposite to the heat. Much has been written about the spheroidal state, but the accuracy of such an analysis is to be questioned. The spheroidal state occurs when water is thrown upon an already highly heated metallic surface, but the possibility of similar conditions arising when the water and metal are initially in contact, and the heat application is gradual, is quite remote. It has been sufficiently demonstrated that the actual temperature rise in the metal wall of a boiler tube is not great. Then, presupposing an adequate circulation in the boiler, the original proposition that a boiler plate cannot be injured when supplied with adequate water contact on one side appears to be substantiated. It is obvious that this is affected by the design of the boiler, and without question the rapidity of circulation is affected widely by the design of the circulation system. Herein is found a legitimate argument by boiler makers in favor of their specific design. Ultimately, that boiler is best which offers the most unrestricted flow of water over its tube heating surface. It is believed that it is safe to eliminate from this discussion any restrictions imposed upon ultimate boiler capacity by the physical considerations of heat transmission.

The heat absorbed by a boiler is always a constant fraction of the heat available. This principle has been thoroughly established by many carefully conducted tests of boilers varying widely in type and size. While the specific value of the fraction varies with the structural design of the boiler and with its physical state of cleanliness, there is no limit in sight where this constant relation fails to hold true. As a direct consequence of this law it is seen that boiler capacity is not limited by the ability of the boiler to absorb heat, but only by the quantity of heat that can be presented for absorption. The question then becomes "How much heat can be presented to a boiler without introducing losses

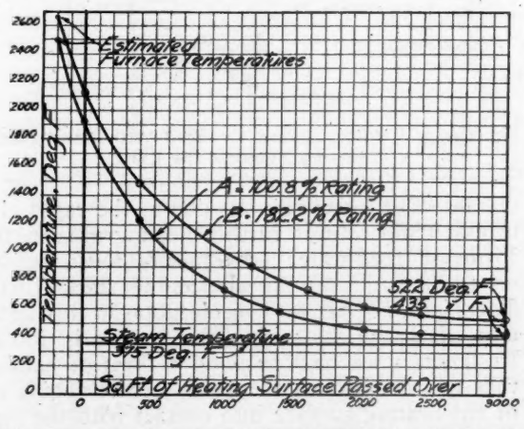


Chart Showing Actual Gas Temperatures at Progressive Points in Passage Through a 300-Hp. Edge Moor Boiler.

large enough to effect the advantage due to the higher rate of steaming?"

There Are Definite Factors Limiting the Capacity of a Boiler.

For the purposes of analysis, this question may be divided into two major parts—the limitation of heat transfer imposed by the limitations to the heat head, and the limitations imposed upon the flow of gases over the heating surface by virtue of the laws relating to the flow of gas through orifices. There is a limitation in both departments, as will be shown.

Assume a furnace temperature of 2500 deg. F. and a terminal, or flue-gas, temperature of 500 deg. F. One of the laws relating to the transfer

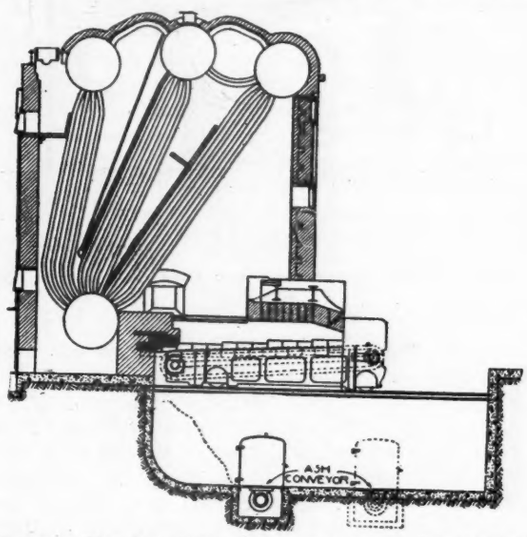


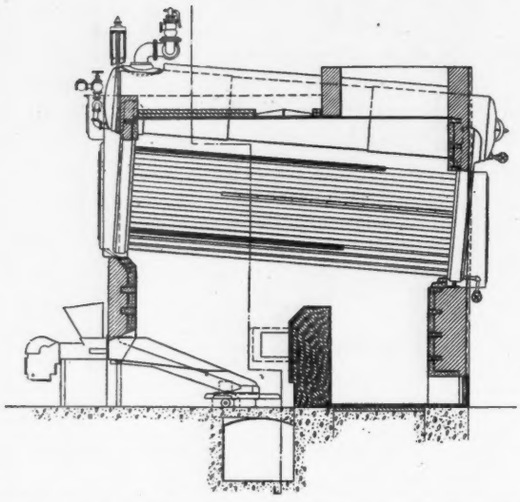
Diagram Showing Chain-Grate Stoker and One Method of Arranging Gas Passages of a Stirling Boiler.

of heat states that "the rate of transfer is directly proportional to the difference in temperature between the two bodies affected." Now, in the case cited, the lower temperature is the temperature corresponding to the steam pressure which, for the sake of specific figures, will be taken as 400 deg. F. Due to other physical laws this temperature is constant throughout the boiler, so that the same lower temperature is presented to the gases of the uptake as well as to those of the furnace.

Mean Heat Head Available Is Limited by Furnace Temperatures.

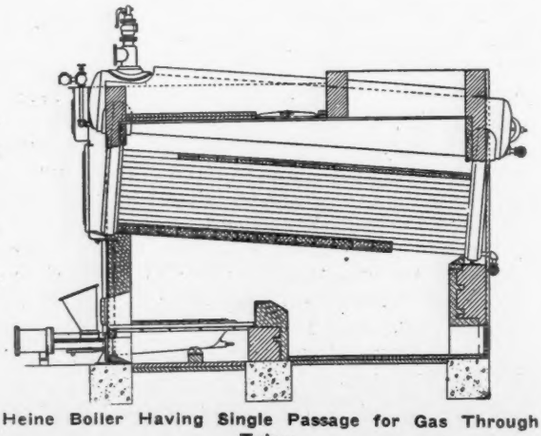
It may also be assumed that the average heat head is a value somewhere between the differences between steam and furnace temperature and the difference between steam and flue-gas temperature. With the temperatures of 2500, 500 and 400 deg. F. already assumed, and assuming a straight-line drop in temperature with passage of gases over the boiler heating surface, the mean or average heat head would be 1100 deg. F. However, the assumption of straight-line temperature drop is not strictly correct, as may be seen from an inspection of the accompanying diagram showing actual gas temperatures obtaining at various points of progress through a 300-hp. Edge Moor boiler. The true mean heat head is the average ordinate between steam temperature and the gas temperature shown on such a curve, and it will vary with the type of boiler and setting, with the boiler condition and, as indicated by the two curves, *A* and *B*, with the rate of steaming.

It is evident that the mean heat head under the conditions assumed will be something less than



Boiler Having Tubes Over the Furnace and Two Gas Passages.

the 1100 deg. F. found as the arithmetical mean of initial and final temperature differences. This head, which for convenience will be assumed as 1000 deg. F., will correspond to a certain rate of heat transfer and will require the passage of a certain volume of gas to maintain conditions uniform. Now, assume that the volume and velocity of gas are increased gradually until the limit is reached while the furnace temperature remains constant. The terminal temperature and the shape of the temperature-drop line will be the only things affected. The final temperature, as is obvious, would increase as the volume and rate of flow of furnace gases is increased, until with an infinitely large volume of gases the terminal temperature would equal the initial temperature. With equal initial and terminal gas temperatures, the temperature-drop line becomes straight and is horizontal. Under these conditions the heat head would be 2500 minus 400, or 2100 deg. F., so that there is an absolute limit placed on the amount to which the heat head can be increased by virtue of increased combustion rates. It would (using the above figures) increase only from 1000 to 2100 deg. F.—an amount which is obviously relatively slight. It would seem, therefore, that inasmuch as the rate of heat transfer is proportional to the difference of temperatures, there is a distinct and arbitrary limitation to the capacity of a boiler as long as furnace

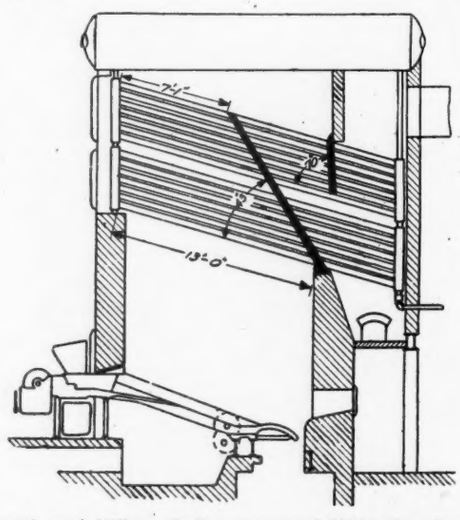


Heine Boiler Having Single Passage for Gas Through Tubes.

temperatures are fixed at a given value. There is not much question but that the limit of initial furnace temperatures with existing commercial refractories has already been reached. Consequently we may not for the present hope to increase the heat head or mean temperature difference by raising the initial temperature above the present limits.

Considering the other phase, namely, the limitation imposed by the laws governing the flow of gases, another very practical matter is found. The frictional resistance to the flow of gas through an orifice varies as the square of the velocity, and in addition there is another law to be taken into consideration that limits the amount of fluid passing through an orifice into atmospheric resistance on the other side. It is unlikely that the latter law could ever be reached under the conditions surrounding boiler practice, but that the former restriction is reached quite soon is well understood. When the higher boiler capacities are developed the draft loss in the boiler becomes of paramount importance, and it is in nearly all cases the factor which limits the development of further boiler capacity in a given equipment.

Induced draft fans capable of producing a negative pressure of three or four inches of water



Babcock and Wilcox Boiler Arranged With Gas Passage Tapering Towards the Exit.

can be readily secured, but due to the rapid rise in exit temperatures further heating area in the form of feed-water economizers must be inserted in order to prevent undue stack losses. Therefore, a practical consideration in this question of draft loss within the setting is found. Designers must have in mind a form of baffling that will accomplish the purpose of bringing all of the heating surface into contact with the furnace gases while not causing excessive resistance to the flow of such gases. That this can be accomplished is not doubted, and that it must be accomplished if capacities are to go where modern conditions demand is not to be questioned. The accompanying illustrations show various methods of arranging the gas passages of different types of boilers. These illustrations are by no means complete as to types of boilers or styles of arrangement, but will serve to show that there

is a great variety of schemes to select from in planning equipments.

Another interesting and highly important phase of this problem of boiler design is encountered when the steam passages in the boiler are considered. A certain velocity is desirable to prevent undue cooling of the steam, but frictional resistance increases rapidly and it is seldom that a boiler is encountered wherein the pressure drop between the interior and the boiler header is not excessive at 300% of rating. Indeed, some boilers are so built that the steam literally cannot get out without pressure drops of 25 or 30 lbs. It is seldom possible to raise the boiler pressure enough to overcome this loss, and it is equally seldom that engine-room conditions will permit of lowering the header pressure by such an amount. Here again is found a most important and practical matter for the boiler designer. Intake pipes, boiler nozzles, superheater passages, and the like, must be made larger than ever before.

Limiting Factors Developed in Actual Boiler-Room Practice.

That these conditions are not mere generalities is proven by experiences of recent date in actually developing limit capacities on existing boilers. An experience with a large standard make of boiler, equipped with a superheater and supplied with draft from a stack about 250 ft. high, developed actual figures substantially as follows: Originally designed for about 175% of rating, the boiler provided a 4-lb. drop in the superheater and a very small drop in the dry pipe and boiler nozzle. As the rate of combustion was carried up under forced-blast stoker-fired conditions, it was noted that the drop of pressure in the superheater rose to a point six times the original figure and the dry-pipe loss mounted to a point which rendered the total pressure drop of the steam in getting out of the boiler to fully eight times the original—an amount which made it impossible to operate without blowing the safety valves.

Changes in both the superheater and dry pipe effected a return to substantially the former conditions—at least the loss in pressure is now not so great but that it can be endured. At the same time the increased volume of gases passing through this boiler increased the draft loss from 0.6 to 1.0 in. of water. If it had not been for the fact that the excess air was reduced to a point where the CO_2 almost doubled, the draft loss would have risen at a much earlier stage and would have imposed a much lower limit upon the steaming capacity of the boiler. As it is, 275% of rating is now readily secured as compared with 175% originally.

When all these conditions are overcome, the boiler heating surface will be available for use to a greater extent than ever before. The tendency of the times is undoubtedly in this direction. Before it is possible to utilize the latest developments in stoker design, the restrictions imposed by the boiler must be overcome. In conclusion, it may be stated that boiler capacity is not limited by any inability of the boiler to absorb heat, but only by our ability to pass furnace gases through the setting and to get steam out of the boiler. As conditions stand today, it appears that stoker design has gotten ahead of boiler design.

CONFERENCE CLUB PLAN MEETS WITH APPROVAL.

The Conference Club held a meeting at White Sulphur Springs, W. Va., Oct. 1-2. L. K. Comstock, president of the organization, stated that several representative jobbers had expressed their willingness to advance the Conference Club plan, which had as a basis the working out of the problems confronting the electrical industry. At the Pasadena convention of the National Electric Light Association the idea of forming an organization which could discuss the problems of the industry with relation to the public was favored by a number of the central-station companies' representatives. After considerable discussion it was decided to appoint a committee to consult with the executive committee and submit a plan of organization based on the ideas expressed by the various members of the Conference Club.

NEW YORK UTILITIES COAL SUPPLY SHOWS INCREASE.

On Oct. 5 the public utility companies of the first district of New York had on hand an aggregate of 427,539 tons of soft coal, compared with 399,676 tons for the previous week. While this increase of about 27,000 tons is not regarded as sufficient to assume the different utility companies an adequate supply for the winter, the Public Service Commission is furthering action to insure sufficient coal to provide for the continuous operation of the electric, steam and gas companies. The Brooklyn Edison Co. had on hand on Oct. 5, 85,935 tons, or 61 days' supply, and the New York Edison Co. 29 days' supply, or 130,529 tons.

CALIFORNIA UNIVERSITY CONDUCTING ELECTRICITY COURSES.

Courses in electricity are being conducted in San Francisco and Oakland, Cal., under the auspices of the University of California Extension Division. Another and more advanced course takes in the higher problems of transmission, storage batteries, measuring instruments, etc. Arthur L. Jordan, head of the science department, San Francisco Polytechnic High School, is in charge of the elementary courses at that point. In Oakland, elementary instruction in direct and alternating current is being given by R. Roy Cowles, assistant superintendent of electric distribution, Alameda County District of the Pacific Gas & Electric Co.

EDUCATIONAL PLANS OF DUQUESNE LIGHT SECTION, N. E. L. A.

The first meeting of the 1920-21 season of the educational committee, Duquesne Light Co. Section of the National Electric Light Association, was held Oct. 4 in Pittsburgh. The purpose of the meeting was to register students in electrical apparatus and steam engineering courses. The interest shown by the men in the educational work of the past season has prompted the new administration to continue this form of section activity. General meetings will be held on the first Monday of each month.

Bonus Systems for Employes in Power Plants

Power Costs per Unit of Factory Production Serves as Basis of Bonus Determination—Division of Total Bonus Should Be Based on Actual Skill and Efficiency of Individual Employe

By ROBERT JUNE

Many factors must be taken into consideration in the establishment of a bonus system for the power-plant employes if the system is to result in maximum economy of operation and maximum satisfaction of both employes and management. Only by a thorough and definite analysis of conditions can the management be assured that the bonus is actually earned, and only on the basis of such analysis can the chief engineer be assured that his men receive a just proportion of the results of superior accomplishments.

Replies to a general letter addressed to a number of chief engineers brought to light a surprising lack of information with regard to the application of the bonus system. Most of the replies requested information instead of giving it, the letter here quoted from being typical of the present situation with the majority of large power plants. "We try to educate our boiler-room men to the fact that power must be produced economically, and that this means that high operating efficiencies must be maintained. We instruct our men in their individual and collective duties, pay them high wages and generally give them to understand that we regard them as skilled operatives from whom we have a right to expect high-grade results. As an incentive to good work we post each Monday, on the bulletin board in the boiler room, the record of overall boiler efficiency for the preceding week.

"While our results in the main are good, we want to improve them. For one thing, we are going to try to separate the percentages of our 24-hr. load handled by each of the three shifts. We are doing this on the principle that one shift handles 50% of the load, another handles 30% and the third handles 20%, and that we should get correspondingly better results from the shifts handling the larger loads. After we have established the proper efficiency for each shift we are going to put in a bonus system of some sort. We are already working on this, but, as you realize, there are a good many angles to the problem and we should be glad to have any information which you may possess, etc."

This, then, is the situation in many large power plants. They are paying high wages, and trying to educate the men, in some cases, by weekly conferences in conjunction with occasional informal lectures on various phases of power-plant operation. Close supervision of the work of the individual and personal leadership evoking a high esprit de corp are the principal reliance at present. It is considered, however, that these are not enough and that a properly devised bonus system probably offers the necessary supplementary incentive.

Turning now to the smaller power plants it is found that they have been more ready to adopt bonus systems. Presumably this is due to the fact that they find it more difficult to provide educational facilities for their men and to exercise a close supervision over their work. While the systems used are not elaborate, they seem to be effective. The point here worth noting is that the tendency in both large and small plants is increasingly toward the use of bonus systems.

Points Upon Which Bonus System Should Be Based.

The term "bonus" may be taken as meaning additional compensation, above a fixed amount, based upon net savings effected through the personal efforts of the recipient of the bonus. As applied to the boiler room, a reasonable efficiency, based upon the results previously attained in the particular plant under consideration and also upon results attained in other power plants of approximately the same size and general characteristics, must be determined upon as a base line or starting point.

Before blindly assigning an arbitrary value to performance above a fixed base line, the relation of the power-plant expenses to manufacturing operations as a whole should be ascertained with some exactiude. The reason is that it will practically always be found that power-plant expenses for any business, so far as the individual plant is concerned, vary along the line of a fixed curve depending upon the output of the plant. That is, if the works as a whole is operated at 100% capacity, power costs will bear a definite relation to the product in terms of pounds, bushels, yards, tons or whatever unit the product may be measured by. Assuming that the power cost is $0.10, $1 or $10 per unit at 100% factory output, at a reduced factory output of 80% it will be found that a different power cost per unit, say $0.12, $1.20 or $12 will prevail. If the works output be still further reduced to 50% capacity, it will be found that the power cost per unit is further increased to, say, $0.15, $1.50 or $15.

Study Is Required to Determine Unit Power Costs.

Determination of this curve is not a simple matter. It cannot be done in a week or a month, but it is well worth the effort even if it takes a whole year. The first step is a complete appraisal

of the power plant including the value of the land and buildings, the complete steam-generating equipment with all accessories, the turbines, feed-water heaters, condensers, pumps, generators, switchboards, fire pumps, sprinkler system, all piping and all wiring which apply wholly to the power plant proper and all main lines of pipe and wire by means of which steam, water and energy are carried to the works centers. With this appraisal in hand, it is at once discovered why the unit power-cost curve is a curve and not a straight line. Power-plant costs fall into two divisions, those which do not vary with the volume of product, and those which do vary with production.

Interest, depreciation, taxes and insurance are examples of the non-variable costs. To these must be added, if the power plant is ready to serve the works with any amount of power up to 100% capacity, the cost of labor, fuel required to bank fires and to keep the prime movers turning over without doing useful work, lubricants, water and ash removal required for standby service, heat and light for power plants, etc. These items vary but little regardless of whether the output is 30% or 100% of full capacity.

Figures Show Economies of Operation.

The variable costs are, of course, coal, feed water, lubricants, ash removal, some equipment maintenance and a certain amount of general supplies such as waste, packing, gaskets, etc. Fig. 1 is a typical graph illustrating the relation of the variable and non-variable cost factors to the volume of production. Fig. 2 is the curve, in this case assumed, resulting from the combination of the variable and non-variable costs per unit of product. Provided with this curve, the manager is ready to talk business to his chief engineer.

In using the curve, the manager does not have to be concerned about a single detail of plant operation. He does not have to study boiler efficiencies, engine performance or economical or

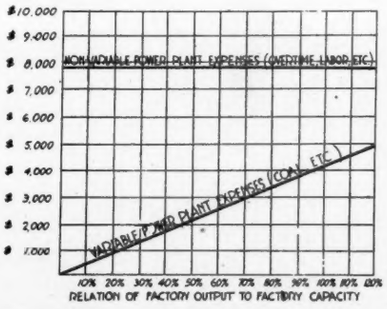


Fig. 1.—Chart Showing Variable and Non-Variable Power Costs.

uneconomical uses of steam, water and electricity. All he needs is the average plant output for a given period and a summary from the accounting department of the complete costs of power-plant operation for the same period. It is a matter of simple division to establish the power costs per unit of output, and to see how it checks up with the standard curve. If the power cost is higher than the standard curve indicates it should be, something is wrong, and it is up to the chief engineer to find out and correct the trouble and to explain to the manager why it should have occurred. If the costs check with the curve, the plant has simply done what it should do and no one is entitled to a bonus. When the actual power costs are less than those indicated on the curve for the volume of product, good management and constructive effort have been exercised in the engine and boiler room, and the chief engineer and every man under him is entitled to a share in the savings.

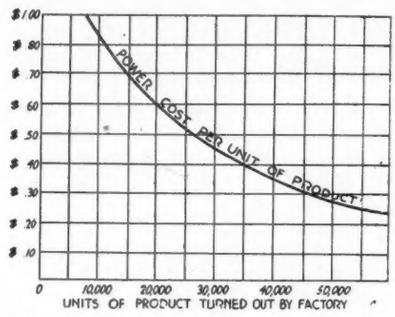


Fig. 2.—Chart Showing Power Costs for Unit of Product.

Chief Engineer Responsible for Total Power Costs.

At this point it may be well to digress for a moment on the point of responsibility of the chief engineer for all items included in the curve under power costs. A man whose engineering record makes him a competent witness, in discussing this matter, says: "Some engineers have argued that it (the curve) is not a fair basis of payment, that all the operating engineer can do is to make steam efficiently, run his engines, pumps, heaters, etc., as well as he knows how, and that he has no control of the situation beyond his department. This is partly true and partly not true. The functions of the chief engineer should extend beyond the confines of the engine and boiler rooms. He should spend at least one-third of his time around the plant, and he should have an inspector in the plant continually watching for improper use of power, light, steam, etc. The chief engineer should be directly concerned in seeing that the process machinery is maintained in an efficient condition. This is particularly true with regard to apparatus that uses steam in any form. If we include in the power plant all the equipment which in any way affects the use of fuel, it becomes a comparatively simple matter to place upon the chief engineer the responsibility for the efficiency of the entire power-making and power-using equipment, and for the power cost per unit of production."

Now, returning to the bonus, the management should decide on some part of the saving to set apart, say, 33.3%, to be distributed as a bonus. Clearly, the chief engineer is entitled to a certain portion of this, and this portion should be determined by the manager. The proportioning of the remainder among the various power-plant employes should be practically in the hands of the chief engineer, since he is in constant touch with and supervises the work of the various individuals.

That the just proportionment of the bonus

among the various individuals will cause the chief engineer some serious study is not denied. It is important, however, that individual rewards be established and that the bonus be not simply divided among the men on a pro rata basis or with reference to their respective wages. The final results are due to the combined efforts of all the men and are beyond the control of any one man.

It is necessary therefore to judge each man on the basis of his performance of his individual work. If boiler efficiency falls off, it may be due to improper firing, in which case the fireman should be penalized, or it may be due to failure to keep the boiler free from soot and scale, in which case the man who does the cleaning should lose all or part of his bonus. The loss in efficiency may, however, be due to leaky boiler settings, a condition outside of the jurisdiction of the fireman and clearly up to the boiler-room foreman.

The principle of individual responsibility applies all along the line. For instance, if a new grade of coal is brought into the plant and the assistant engineers do not make it their business to see that the firemen are instructed regarding the proper method of firing, they are guilty of a breach of duty for which they should suffer. The engineers are, of course, responsible for permitting radiation losses to continue because of failure to insulate pipes, and for failure to correct leaky valves, traps, worn gaskets, etc.

When the bonus is not earned by a particular individual it may be due to his not following instructions, to faulty maintenance making compliance with instructions impossible, or to faulty supplies. With so many angles to the problem, it is evident that close inspection and constant supervision of the work of the individual is absolutely necessary if material reductions in power-plant costs are to be made.

It is realized that the program here outlined may seem elaborate. The small-plant operator in particular may think it complicated but it is precisely in the small plant that astonishingly good results can be attained. Admitting elaborateness, this basis of bonus is certainly thoroughgoing. To the writer's mind, there is no point whatever to paying firemen a bonus for high CO_2, or for high boiler efficiency, if no corresponding effort is made to see that the steam when produced is utilized without preventable waste.

WATER-POWER DEVELOPMENT A FACTOR IN CANADIAN INDUSTRY.

Cheap and Plentiful Power in Cities of Canada Gives Material Advantage to All Branches of Industry.

By Edward J. Dies.

Development of water power with the subsequent development of the manufacturing industry is going forward in western Canada at a rapid pace. Winnipeg, which a century and a quarter ago was only a fur trading post, today is referred to as "The Chicago of the North." Its growing importance as a manufacturing center is attributed by leaders of industry to the fact that the city has the cheapest power in America. Of course, in addition to its advantages from water power, Winnipeg is a great primary grain market, financial center of western Canada, the pivot point of five great railway systems including the Canadian National Railways, and the dominating influence over a half billion-acre area populated by 2,000,000 people.

Winnipeg recently completed a $16,000,000 aqueduct which now supplies the city with pure soft water from Shoal Lake, Ontario, 100 miles distant. The daily capacity is 100,000,000 gallons, and the supply, which is of excellent quality, is inexhaustible.

The newest addition to Winnipeg's power system is a $9,000,000 hydroelectric plant which will have an ultimate supply of 168,000 continuous horsepower. The city supplies hydroelectric power to manufacturers at as low a rate as $0.005 per kw-hr., and the power supply available is sufficient for a city of ten times the size. On the subject of water power, the Dominion government has prepared the accompanying comprehensive table showing the power available in each province and also to what extent it already has been developed.

TABLE SHOWING THE AVAILABLE AND DEVELOPED WATER POWER IN CANADA.

		——Total horsepower developed——			
Provinces.	Total available horsepower.	For the electrical industry.	For paper and pulp industry.	For other industries.	Total
Ontario	5,800,000	632,083	83,375	74,008	789,466
Quebec	6,000,000	370,000	100,000	50,000	520,000
Nova Scotia	100,000	3,062	12,650	5,700	21,412
New Brunswick	300,000	5,890	3,050	4,450	13,399
Prince Edw'd Island	3,000	50	.....	450	500
Manitoba ..	3,500,000	76,200	.....	50	76,250
Saskat'wan		.....	.....	100	100
Alberta		32,860	.....	.....	32,860
British Columbia ...	3,000,000	216,345	49,000	4,275	269,620
Yukon	100,000	12,000	.....	.....	12,000
Total	18,803,000	1,348,490	248,075	139,033	1,735,598

With but few exceptions all principal cities, and by far the greater number of towns and villages, are supplied with hydroelectric energy, and the surplus production permits of the exportation of considerable power from New Brunswick to the state of Maine, from Quebec to New York, from Ontario to New York and Minnesota and from British Columbia to Washington. In western Canada industrial development is proceeding at a rate little appreciated in this country. In most cases this development is due to water-power facilities. The government of the Province of Alberta in its official publication is now devoting an entire section to industrial news of that province with particular attention to water power. In the last issue it was stated that there were 208 factories in actual operation in the province giving employment to 3171 people.

EXPORT OF ELECTRIC LIGHT BULBS FROM JAPAN.

An estimate of the total output of electric light bulbs in Japan for this year is given as 14,000,000 pieces. The demand for bulbs for home consumption is increasing and orders are forthcoming from India, China and the islands in the south.

Use of Electric Locomotives in Coal Mines

Electric Power Haulage Systems Necessary to Secure Maximum Production and Profitable Operation — Features of Trolley and of Storage-Battery-Driven Gathering and Haulage Locomotives

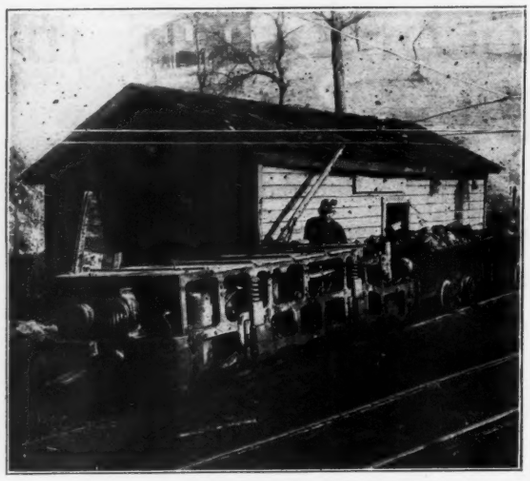
Power haulage is becoming a more and more important factor in the profitable operation of coal mines. With the demand for coal greater than the supply and wages continually advancing, machinery must be used as much as possible in coal mines to secure maximum production and profitable operation. With working faces receding further from the shaft, the more necessary it becomes to employ power haulage, and, where workings are a long distance from the shaft, power haulage is the only way of transporting coal economically. Mines abandoned as unproductive have again been put into operation by installing improved haulage systems. In the main haulage mechanical methods can be employed with the greatest advantage, superseding manpower or ponies, while the gathering can also be done more economically by means of mine locomotives. The elimination of pit ponies from coal mines is desirable for humanitarian reasons as well as for sanitation.

Of the various types the electric mine locomotive seems to have best solved the haulage problem, and is now recognized as being the most successful motive power for mine systems. The electric locomotive is strong, durable, reliable, compact and easy to operate. The steam locomotive, for underground operations, is objectionable because of the gases driven off and the high headroom required. Gasoline locomotives are not suitable for mines unless the ventilation is exceptionally good so that the exhaust is not objectionable. Compressed air locomotives have a limited radius of action because of their small storage capacity and their low efficiency.

Electric locomotives are used on the main haulage roads, and, when fitted with cable reels and crab devices, are used for gathering. With crab devices on a gathering locomotive it is unnecessary for the locomotive to enter the chamber, thus eliminating the danger of igniting the gas at the working face through operation of the motor. Gathering locomotives have electrically operated cable-reel or crab devices or both and have trolley attachments in all cases for operating on the main haulage system. The cable-reel locomotive enters each section of room and approaches the working face when gathering or returning cars. The crab locomotive does not enter the room, but takes its load from a position on the entry near the room mouth, the loaded cars being pulled out of the room by means of a flexible wire rope operated from the locomotive. The combination gathering locomotive combines the features of both the crab and cable-reel types, and is used when it is desirable for the locomotive to enter some of the rooms only. The electric trolley locomotives for plain haulage are not equipped with cable-reel or crab gathering devices, but in other respects are like gathering locomotives.

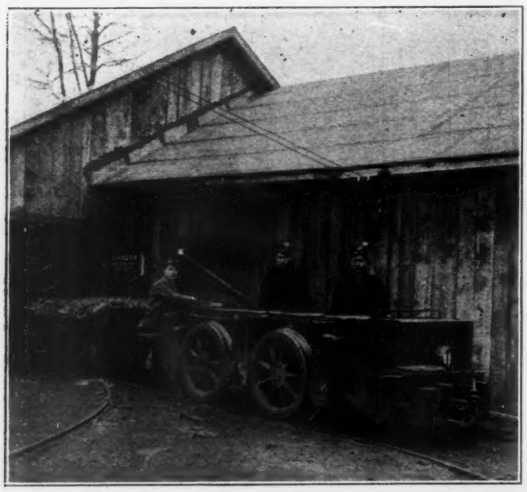
Electric mine locomotives of the trolley type have a practically unlimited radius of action, and are used for surface haulage as well as underground. Being compact, they can be used under-

Special Type of Storage-Battery Locomotive With Batteries Carried Between the Two Ends of the Locomotive.



Type of Powerful Mining Locomotive.

ground where headroom is limited and where the cost of increasing the height would increase the cost of mining. Where the main haulage roads are free from gas, there is no danger from the use of trolley locomotives on these roads. Gathering locomotives generally range from 4 to 7 tons and straight haulage trolley locomotives are more powerful, ranging in weight from 10 to 25 tons. The locomotives have, as a rule, two motors, this combination having proved more efficient than the one-motor type. The motors are mounted in tandem or central. In the former case the rear motor is placed between the axles and the other motor between the forward axle and front end frame while in the central method of mounting both motors are placed between the axles. Tandem mounting allows for a shorter wheel base and is suitable for the lighter locomotives which are usually required to operate over tracks with short curves. The central mounting is suitable for heavier locomotives used on main haulage work where the longer wheelbase is allowable. The main idea in all cases is to give an equal distribution of weight on all the wheels. Motors are usually mounted on the axles, with suitable spring suspension, and the drive may be either through gears or by means of a chain. The motors are, as a rule, equipped with ball bearings



Mine Locomotive That Hauls 12 Two-Ton Loads at a Time.

which allow for the maintenance of a uniform air gap and result in cleaner operating conditions. Ball-bearing motors reduce maintenance charges and are more continuously in service.

Electric locomotives are also operated by means of storage batteries. In many places where the mine roads are level, or grades favorable, and where the haul is not too large, the storage-battery locomotive offers certain advantages over the cable-reel locomotive. When the storage-battery locomotive was first introduced it failed to give satisfactory service because the batteries were not suitable for the hard service and the motor was not efficient as a battery motor. In recent years, however, with the marked improvement in the durability of batteries and more efficient motors, storage-battery locomotives have been giving satisfactory service and are standing up under severe operating conditions. The outstanding features of a storage-battery locomotive are that it is self contained, it requires no overhead-trolley cables and eliminates the expense of bonding rails. One make of storage-battery mine locomotive has roller bearings on the journals, and ball-bearing motor armatures, each of the two axles being driven through gears by a separate motor. They range in weight from 2 to 6 tons, the largest size being able to haul 12 tons on the level and to operate on any grade up to 10%, the load capacity decreasing as the grade becomes more severe.

Electric Coal-Mining Locomotive Operating on the Surface.

The design of electric locomotives varies according to the make, but, generally speaking, there is a great deal of similarity in all types. The main object is to produce a rugged, compact machine capable of resisting shock and standing up under hard service.

FIXTURE DEALERS' MEMBERSHIP CAMPAIGN.

The executive board of the Electrical Fixture Dealers' Society and the executive committee of the National Council of Lighting Fixture Manufacturers have authorized a campaign for membership in the dealer organization. Arrangements have been made for the manufacturers' salesmen to sign up memberships for the dealer organizations, prizes of $500 being appropriated for the salesmen obtaining the most memberships.

Factors Contributing to Boiler-Room Efficiency

Large Boilers With Well-Planned Furnace, Setting and Baffle Construction Give High Capacity and Good Operating Conditions — Paper Before Annual Convention of Michigan Section, N. E. L. A.

By R. G. FELGER
Detroit Edison Co.

The 2365-hp. W-type Stirling boilers of The Detroit Edison Co., which have caused much comment by engineers on account of their size, efficiency and operation, are now a permanent and established equipment in the steam-power world. All builders of boilers are now ready and willing to erect almost any size boiler the customer requires, giving up the old idea of small boiler units. This has resulted in great progress in economic operation of steam power plants, and the results which have been obtained are amazing.

The Detroit Edison Co. has 19 of these large W-type boilers in operation in their generating plants and four more are under erection. Two new generating plants which will soon be erected will also be equipped with these large boilers. Ten of the boilers which are now in operation are installed in the Connors Creek power house. The first one was installed in 1914, and units have been added every year since that time. The four boilers, which were mentioned as being under erection, are being installed at the Connors-Creek power house. The other nine boilers are in operation at the Delray power house No. 2. The company has also seven 1300-hp. boilers of the W-type in operation and two under erection. The smaller boilers are similar to the larger type, but with drums only half as long. Five are used in the central heating plants and two have been installed in the Delray power house No. 2 on account of the limited floor space.

It is the object of this paper to present the recent developments in the equipment of the large boilers, and to show the changes which were made and are being made on the settings and stokers to insure more uniform operation and to obtain better efficiency. There have been practically no changes on the boilers themselves, since they have proven satisfactory in every respect. The boilers have been tested in every way possible, both during tests and actual operation, and no suggestions for any changes have been made.

Feed-Water Treatment in the Power Houses and Central Heating Plants.

In the Connors Creek power house tube troubles have almost completely been eliminated by the use of distilled water. Live steam is used

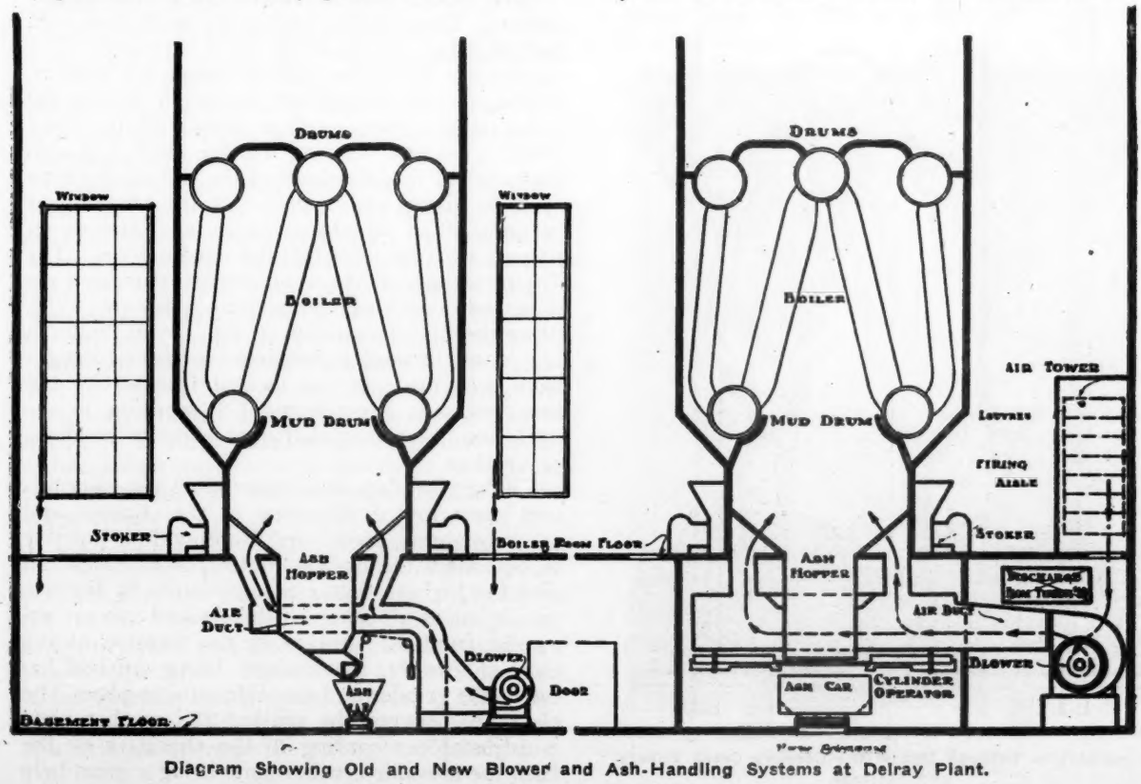
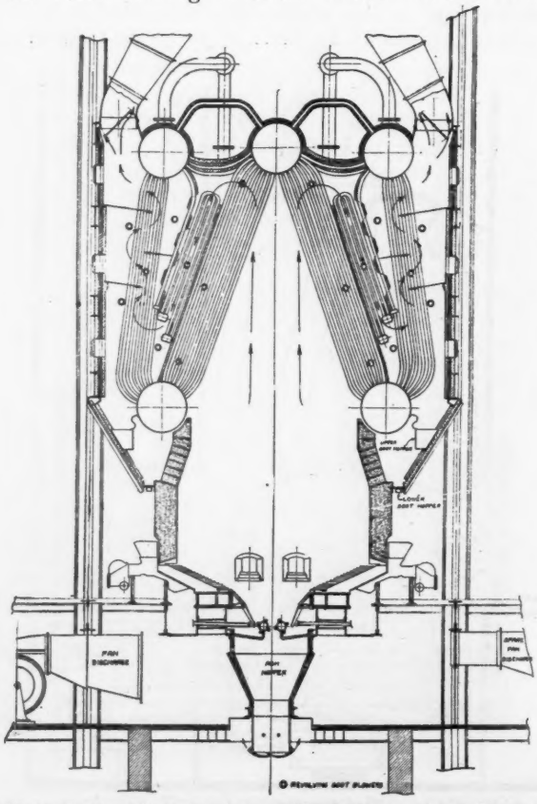


Diagram Showing Old and New Blower and Ash-Handling Systems at Delray Plant.

for evaporating the raw make-up water, the heat being kept in the system by using main turbine condensate for cooling water in the distillation process. The Delray generating plant uses one of three boilers as a make-up boiler, all water which must be added to the system being fed to one of the three. These boilers are blown down more than the others to prevent excessive scaling. The feed water is treated at the pump suction.

All boilers are given a complete overhauling once a year at which time all tubes are turbined, no scraping of the drums being necessary because of the almost complete elimination of scale. Every six months the front bank of tubes is turbined so that any scale which has formed, especially in the front row, is removed. These surfaces are worked very hard and any small amount of scale may cause a bag on a tube. All boilers are externally inspected every four to six weeks at which time the repairs to the furnace are made. The boilers are blown down once a week except at the Delray plant where the interval is once in 24 hrs. Samples of the blow-off water are taken and their conductivity is determined by a Dionic tester. The blow-off samples from the boilers in the Delray power house are also tested for alkalinity by titration to determine the quantity of soda ash to be used.

In the central heating plants distillation of the boiler feed water is not feasible because the make-up water of these plants is about 85% of the total output. Detroit river water, which is used in these plants, contains various scale-forming materials which cause unlimited trouble if not treated correctly. In 1915 a complete analysis of the water was made to determine the chemical treatment necessary to precipitate or eliminate the scale-forming material. After various tests, which covered a period of between two and three months, soda ash was decided upon and it has given very satisfactory results.



Cross-Section Through One of the Connors Creek Boilers and Settings.

The method of feeding the soda ash is original and is considered worthy of description. The soda ash is dissolved in a mixing tank and is pumped to a small constant-level tank above the feed-water heaters. The amount fed is controlled by a syphon which is raised and lowered in the constant-level tank by means of a wire attached to a steel mercury float, the mercury legs being connected to a venturi tube. Difference in head of water caused by the quantity passing through the throat controls the amount of soda-ash solution in direct proportion to the quantity of raw water.

Feed water is pumped from the feed-water heaters into live steam purifiers located on top of the boilers. Most of the silica and sulphate scale-forming materials are dropped in the purifiers, and are removed from the system by blowing down. The purifiers are easily cleaned by removing the pans and scraping the incrustations from the pans and shell. This is done during semi-annual repairs of the boilers. Of course, there is some further precipitation of the sulphate scale in the boiler, this being eliminated by the use of the soda ash which changes the hard sulphate scale to the softer carbonate which is removed in the blow-off. Both purifiers and boilers are blown down once every 24 hrs., and a sample of the water is taken at each blow-down and its conductivity is determined. There is also an alkalinity test made of the blow-off water each week, and the rate of feeding the soda ash is varied according to the demand indicated by this test.

Stoker and Clinker-Grinding Equipment.

Most of the boilers are equipped with Taylor stokers. The 2365-hp. boilers are fired from both ends, thirteen retorts being set at each end. The stokers are driven by variable-speed d-c. motors, it being a great advantage to be able to run the stoker at any given constant speed. Morse silent chain is used for driving the line shaft and also for each individual section of the stoker, this type of chain giving less trouble with the breaking or jumping off of the chains which was often experienced with the old-style-link chain drive. The Taylor stokers used are of the two-plunger (one upper and one lower plunger to a rambox) type. Since the first installation of the Taylor stoker it has passed through a complete evolution. Changes have been made by the Detroit Edison Co. and the American Engineering Co. working in co-operation, the principal change being in the clinker crusher.

Clinker grinders have eliminated the intermittent operation of disposing of the clinkers and ashes by dump grates, and have made it possible to cut down the carbon content of the ash, and give the highest degree of uniformity in furnace conditions at all times. Clinkers and ash are removed from the furnace by the rotation of the toothed grinder, the clinkers being crushed between the grinder and movable crusher plate. The clearance between the crusher and crusher plate is adjustable according to the character of the fuel, the movable crusher plate being a great help

to the fireman in keeping his furnace conditions uniform.

The clinker grinder at the present time is driven through a connection to the long-stroke link on the end retorts of the stoker and a ratchet wheel connected to the end of the grinder shaft, the speed being limited to the speed at which the stoker can be driven. In the case of slow-burning coal with a high ash content the dirt cannot be removed fast enough to keep the grates clear of clinkers, thus causing furnace troubles and cutting down the boiler rating. This trouble will soon be eliminated by an individual motor drive which can be operated at any desired speed. Since the coal used at the present time is of very poor quality, with a large content of low-fusing ash, there has been some trouble with the wearing of the grinder teeth. The shell remains in good condition, but the worn teeth make it almost useless. The shells are now made with removable teeth so that when the teeth are worn down they can be easily replaced by new ones.

Features of Furnace Reconstruction.

When the dump grates were removed from the boilers in the Delray generating plant and the clinker grinders were installed, a new problem immediately came up. More head room is required for the grinder than for the dump grates, and this could not be obtained on account of the original construction of the boiler room. This made the ash pit very shallow, and the grinder pit was too narrow to allow extension grates to be installed. Live coke was a constant menace to the grinder, and the small ash pit was a trouble-maker. These furnaces are now being rebuilt. Although they cannot be made as satisfactory as the Connors Creek furnaces, which have ample head room, most of the troubles will be overcome. The stokers on both ends of the furnaces have been moved back, making the grinder pit wider. The pit is also being made deeper and extension grates are being installed, furnishing air to the coke which topples into the pit and completely burning it before it reaches the grinder. The moving back of the stoker also increases the furnace area and a better rating of the boiler is obtained.

The ash pit has been made wider, giving more space for the ashes so that they do not have to be removed so often. Ash gates are controlled by compressed air to make handling easier and quicker. The ash conveying system, which is also being rebuilt, will use a standard-gauge steel car of low design to accommodate the small headroom under the ash hoppers. These cars will be hauled by a stroage-battery locomotive. The design of the air duct has been changed to conform to the installation of extension grates. Other minor changes were also made to increase the convenience of shifting from regular to the spare blowers.

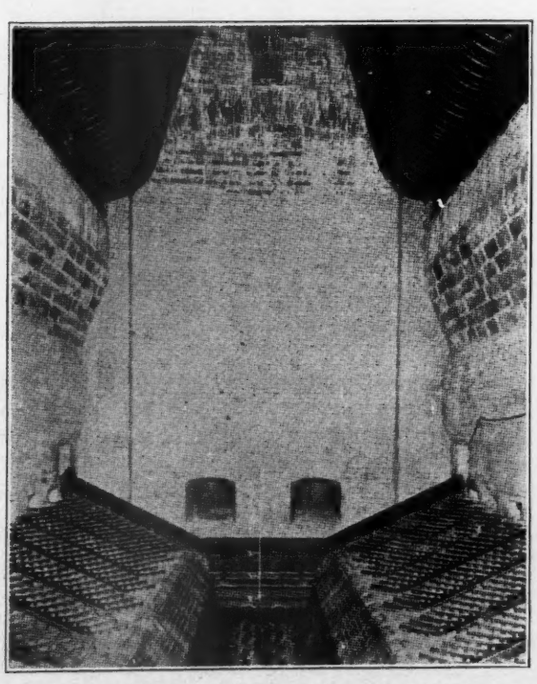
The steam turbines, the original driving units of the blowers which furnish the under-fire air pressure for the stokers, are being replaced by d-c. variable-speed motors. This gives a greater range of speed and also eliminates the auxiliary steam apparatus. There is a blower for each boiler furnace and a spare blower to take care of each boiler. When the regular blower is shut down the dampers in the passage to the air duct from the crippled blower are so arranged that air is provided from the spare blower.

There was much objection to the old arrangement of air supply to the blowers, the chief one being that the men on the boiler-room floor and in the ash tunnels were constantly exposed to a draft of the outdoor air being drawn into the blowers through the outside windows and doors. In cold weather this draft in sweeping across the operating space was a serious discomfort to the boiler-room force, and the chief reason for changing the air supply system was to better working conditions. With the new arrangement stoker air will be drawn from outdoors through towers, which were used for cable vaults, into the blower gallery. This arrangement obviates creating a draft through the ash tunnel and boiler room.

The Connors Creek plant was so constructed that all of the troubles mentioned above were eliminated. The boilers were set high enough to allow a standard-gauge steel railroad car to be run under the ash hoppers for the removal of the ashes, and one man takes care of the ash handling for ten boilers, the yard engine and crew placing and moving the cars. Air ducts are large chambers which have practically eliminated eddy currents and pockets of air. The firemen are able to go into this air chamber to observe the clinker bed above the grinders and to detect holes which would permit live coke to fall into the ash pit. This is a great aid to the workmen because small holes are sometimes hard to see through the firing doors.

Boiler Settings and Baffle Changes.

For the elimination of the side-wall clinker, side air ducts are now built between the last tuyere box and the side wall. Air comes in at the bottom end of the duct, passes through to the top and then into the tuyere box. This gives a good circulation of air through the duct and pre-



View of Interior of 2,365-hp. W-Type Boiler, Showing Clinker Grinder and Tuyers.

vents the burning of the cover plates. Clinker is now easily removed because it is not so heavy and has no fire brick surface to adhere to. Experiments have also been made using various kinds of high-fusing-point bricks for furnace linings above the air duct and rambox caps, and the carborundum brick has proven to be the best. The clinker does not seem to adhere to the brick on account of its high fusing point, and there results a great saving of repair work in the boiler setting.

Since the side air ducts add about 18 ins. to the width of the stoker, not changing the length of the boiler drums, it was necessary to build sloping walls. This was accomplished by building a hanging wall of fire brick shapes supported by cast-iron and steel supporting frames. Each individual brick is held in place by a cast-iron clamp which, in turn, is supported by a cast-iron hook, the hook being so designed as to fasten in a groove in the clamp and hook over an angle iron in the supporting frame. Any individual block can be removed without disturbing the surrounding blocks so that the wall can be easily repaired. This makes a very flexible wall and at

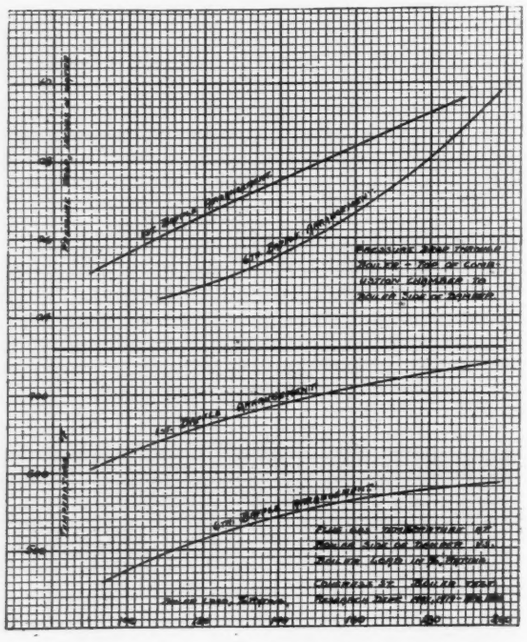


Chart Showing Results Obtained by Use of New Baffle Arrangement.

the same time fulfills all requirements and eliminates the expansion joints of the former settings.

The original baffle of the 1300-hp. boilers installed in the heating plants was unsatisfactory, the flue gas temperature being very high and the drop through the setting also being high. A series of tests was run to determine what changes could be made to produce the best results. There were six different designs of baffles studied in six different tests. The results obtained were considered satisfactory, and the baffles of all the heating-plant boilers are being changed this summer. The accompanying illustration shows the changes that are being made. The half-boiler section shown to the right represents the old baffle arrangement, while the section to the left represents the new scheme adopted. An idea of the actual results obtained with the two types of baffles may be obtained by examining the curves showing flue-gas temperatures, and pressure drop through the boiler, while operating at from 100 to 200% capacity.

Steel economizers are not considered feasible by most engineers on account of the corrosion, but one experimental steel-tube economizer has been in operation at the Delray plant for between four and five years and has thus far proven

TABLE SHOWING PERFORMANCE OF BOILERS AT CONNORS CREEK PLANT, DEC., 1918, TO MARCH, 1919.

Month.	Total water fed to boilers, M lbs.	Total coal consumed, M lbs.	Heating value of coal, B.t.u. per lb. as fired.	Per cent carbon in ash.	Per cent ash in coal.
December	420,765.6	52,359.5	12,644	13.73	12.55
January	485,853.0	64,564.1	12,363	11.81	13.61
February	392,198.7	53,823.0	12,660	10.09	12.81
March	458,967.2	61,926.8	12,440	13.72	12.83

satisfactory. The hot flue gases are drawn through the economizer by an indirect-draft fan and then pass to the stack. Arrangements are now being made for a permanent installation of steel-tube economizers, and the results obtained will determine whether additional installations will be made.

To eliminate trouble with the burning of flue-blower elements in the first pass of the boilers, several telescopic flue blowers have been installed. The blowers were installed at the top of the first pass where most of the trouble was experienced. Soot originally collected on the tubes in large lumps hindering the passage of the gas and causing a large drop through the setting, and high furnace temperatures. These telescopic units have been in operation about four months and have proven very satisfactory. The blower is used only when the boiler load is very low or while the boiler is banked.

Special Instrument Panel Used for Boiler Control.

The control of each unit which concerns the operation of the boiler, excepting the boiler-feed-water regulation, is brought to one point in front of the boiler. This arrangement minimizes the time required for regulation and affords a most perfect control of all operating conditions of the boiler. Mounted on the gauge board are the stoker-motor controllers, blower-motor controllers, Uehling CO_2 recorder, steam-flow meter, saturated and superheated steam gauge, underfire pressure gauge, overfire draft gauge, a damper-draft gauge for each side of the boiler, tachometers showing revolutions of stokers and the damper-control switch. The damper is operated by a small motor, geared so that the travel of the damper is very slow. The damper motor is controlled by a double-contact, manually-operated switch located on the gauge board. The operation is so simple that an open damper is very seldom found, the fireman keeping the desired over-draft almost unconsciously. This regulation is a great improvement over the former damper regulators and is a step toward efficiency.

Pyrometer systems have been installed in some

of the plants, and it is the intention to install them in all plants. The latest installation consists of a potentiometer system giving the average temperature of three thermocouples connected in series, the thermocouples being located at different points in the same crosssection of

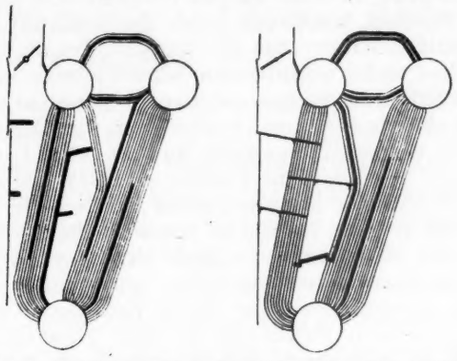


Diagram Showing Old and New Baffle Arrangements. New Baffle to the Left.

the uptake just below the damper. Experiments are now being conducted to improve upon this system. All instruments are kept in first-class condition. They are cleaned and those that need checking are checked every day. An instrument must be correct if the desired results are to be obtained. An instrument out of order plays upon the morale of the fireman because he will soon ignore it and allow various difficulties to arise. A daily-routine instrument sheet which covers each instrument in the boiler room is used by the instrument men. This sheet is filled out each day and the general conditions of instruments can easily be checked by the engineer.

Testing Laboratory Aids in Plant Operation.

Since the average consumption of coal of The Detroit Edison Co. plants is approximately 4000 tons a day, something may be said of the testing laboratory. The proximate and ultimate analysis require no comment, but the determination of the fusing temperature of coal ash will be described briefly. The ultimate efficiency of coal depends on the nature of its ash; upon the manner in which it behaves in a boiler furnace where it becomes intensely hot, and may cause serious operating difficulties if it fuses and flows. Tests show that ash samples of "good" coal should not fuse at temperatures much below 2500 deg. F.

The fusing point is obtained by making small pyramids of the ash, the ash particles being held together by a solution of dextrine. These are placed on a fusion block with a standard Seger cone fusing at 2500 deg. F. The fusion block and cones are placed in an oil-fired furnace and the temperature is raised slowly to 2500 deg. F., the furnace-temperature cone being checked by an optical pyrometer. Much valuable data which will prove of great importance in both the purchasing and utilizing of coal in the boiler furnace has been obtained by the fusion test. A record of the condition of the cone after being taken from the furnace is kept by photographing the block upon which the samples are placed.

The general scheme of this company is to give every boiler operator full charge of all operations of the boiler he is firing, the boiler-room foreman assisting him if it becomes necessary. He is not held down by an instrument which does the thinking for him; he must think for himself. This has been found the most efficient method, and he soon learns to eliminate operating troubles much better than the "brain" instrument. With the opportunities given the fireman he becomes much interested in his work and strives to keep his boiler in ideal condition. Almost any fireman who has been employed by The Detroit Edison Co. for any length of time is able to explain in detail any part of the stoker or boiler, and this knowledge must be had to attain the best working conditions and the highest boiler efficiency.

STATISTICS SHOW DEVELOPMENT IN SOUTH AMERICA.

Telephone Company Compiles Data Giving Valuable Information on Commercial Progress in South and Central America.

Figures showing the development of the South and Central American republics are made public as a result of a survey by the American Telephone & Telegraph Co. These statistics, which were prepared with the co-operation of the various governments, cover the telephone and telegraph systems of all the countries south of the Rio Grande river. The figures are serviceable as indices to the general state of development and of commercial progress in the various American countries and should therefore prove of value to all interested in those countries.

Some of the conclusions reached are that in the southern countries the telephone is far from being the universal means of communication that it is in the United States, and that the main development there is in the big cities, the other areas being very poorly served. The telephone network is about 100 times as dense in this country, as a whole, as it is there. In point of the number of telephones per 100 of population, the service here is over 30 times as good.

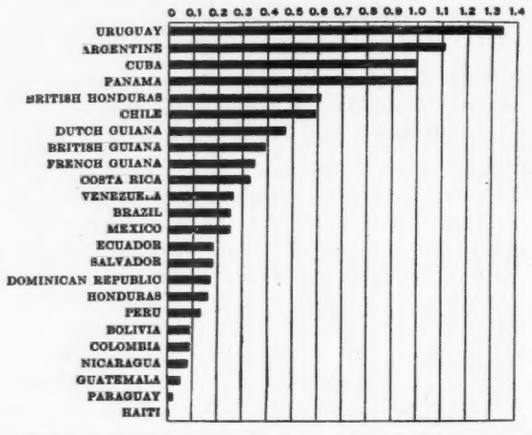
The total of 325,403 telephones in all the South and Central American countries, including Cuba and Haiti, should be compared with the 12,000,000 in the United States, which have about the same total population. Argentine leads with 105,205 telephones, or nearly a third of the total. The other countries having more than 10,000 telephones are: Brazil, 67,366; Mexico, 40,211; Cuba, 28,152; Chile, 23,670, and Uruguay, 19,486. Haiti, with a total of 2,500,000 people, has 82 telephones.

Only one telephone for about every 300 population is found in the whole area, as compared with 11.39 for every 100 population in the United States at the same date, or about 34 for every 300 population. Uruguay leads the Latin-American countries in point of telephone density with 1.34 telephones per 100.

The total telephone wire mileage is 905,587, compared with 29,800,000 in this country. Taking into consideration the fact that the total area of the South and Central American countries is 8,476,600 square miles, compared with the 3,027,000 square miles of the United States, there is only about one-tenth of a mile of wire

for every square mile in the Latin countries, while there is nearly ten miles for every square mile here. This means that the telephone network is nearly a hundred times as highly developed here as down there.

The investment in telephone systems in all the Southern countries is $64,422,000, compared with $1,600,000,000 in the United States. The per capita investment is 71 cents in South America, compared with $15.09 here. The gross earnings in 1918 of South American telephone systems were only 18 cents per capita, while in this country they were $3.99. The gross earnings per telephone were, however, $52.82 down there and only $34.98 here. Of the total telephone and telegraph earnings in 1918 in the



Telephones per 100 Population in South and Centra American Countries, Jan. 1, 1919.

Latin countries, the telephones brought in only 43.5% of the total and the telegraph 56.5%. In the United States this situation is strikingly reversed—80.8% from telephones and 19.2% from telegraphs. The total telegraph wire mileage is 433,938 down there and 1,900,000 here. The number of offices are 11,627 and 28,900 respectively. The number of messages sent in 1918 was 41,517,200 in the Southern countries, as compared with 170,000,000 here.

The telegraph statistics therefore show a more favorable comparison with those of this country than do the telephone figures. The reason is that the telegraph is used more by a specialized class of the population mainly for business. The telephone has not in the Latin-American republics come anywhere near being the universal and democratic means of communication that it is in the United States.

GOVERNMENT OF MEXICO TO ACQUIRE UTILITY PROPERTIES.

Bond Issues to Be Floated to Take Over Large Power and Transportation Enterprises in Plans for Rehabilitation.

Foreign investment interests in Mexico express much surprise at the authoritative announcement which has just come from the capital to the effect that the Mexican government plans to purchase the extensive holdings of the Mexican Light & Power Co. and the Mexican Tramways, Ltd., including the great hydroelectric plant at Necaxa. It is stated that an inventory of these properties has just been made and that the proposed purchase price has been practically agreed upon by the interests involved. The making public of the government's plans to acquire these holdings was all the more of a surprise, coming, as it did, upon the heels of an authentic statement that the Mexican Tramways, Ltd., had under consideration plans for resuming construction work upon its two proposed interurban electric lines, one to run from the City of Mexico to Puebla, 130 miles, and the other from the City of Mexico to Toluca, 45 miles. More than $12,000,000 were expended in the building of dams for the storage of water in the mountains, the installation of a hydroelectric plant of 200,000 horsepower and the construction of power transmission lines from Necaxa to the City of Mexico, Puebla and El Oro. How much money in addition to this was invested in the lighting systems and street railways of the capital and Puebla is not publicly known. The Mexican Light & Power Company and the Mexican Tramways, Ltd., are owned by a British syndicate. The development of the big projects was carried on during the latter years of the administration of the late President Porfirio Diaz, under the direction of Dr. F. S. Pearson of New York and London. The same interests own a 3,000,000-acre tract of timber in Chihuahua, several large lumber mills, and the Mexico Northwestern Railroad which runs from Juarez to Chihuahua.

While no official announcement has as yet been made on the subject, it is reported on trustworthy authority that the Mexican government is also planning to take over the Mexico Northwestern Railroad. This property suffered great losses and damage during the long period of war and banditry and has a claim for several million dollars against the government.

It is the purpose of the government to finance these pending transactions by issuing bonds, which will be retired from the profits of the companies. The details of how this financing is to be accomplished are lacking, however, in the preliminary announcement of pending negotiations .

DOUBLING RATE ON ENERGY CAUSES FILING OF COMPLAINT.

The borough officials of Middletown, Pa., have filed a complaint with the state public service commission against the York Haven Water & Power Co. and the York Haven Electric Transmission Co., holding that the utilities have broken their contract with the borough. The complaint is one of the most unusual brought to the attention of the commission; it sets forth that in 1906 the municipality disposed of its power plant at a loss, entering into what was deemed an advantageous contract with the electric companies for energy at the rate of 1 cent per kw-hr. for an indefinite period, the borough to have the right to terminate the agreement on six months' notice. The complaint is tendered because the rate is doubled in a new tariff filed by the central-station companies, and which became effective Oct. 1.

EDITORIAL COMMENT

Limitations to Ultimate Boiler Capacity

For some years past engineers have been devoting much attention to the efficiency of conversion of energy from fuels to electricity. Generators, prime movers and boilers have all been produced in larger and larger sizes, and every effort has been made to increase the efficiency of the various equipments. Good business will not in some cases permit of the utilization of designs of the highest physical efficiencies attainable because of excessive investment costs or other similar factors, the real object of those operating boiler plants being to produce and market energy at a minimum cost.

The physical inability to increase the sizes of boiler plants rapidly enough to care for the growing power demands makes it essential, in many cases, to find means of increasing the output of present equipment if existing requirements are to be met. Numerous boilers are now being worked at 100% or more in excess of their rated capacity, and the question has been raised many times of how far it will be possible to exceed the standard ratings of boilers with safety and with economy. In a series of articles, the first of which appears in this issue, Mr. Joseph Harrington, who is too well known among the engineers and executives of the power-plant and central-station industry to need formal introduction, will discuss various features of boiler design and operation, furnace and stoker performance and fuel conditions in their relation to the ultimate limits of capacity that may be developed in existing or possible future plants. The present article deals only with the boiler itself, and points out the fact that simple rearrangement of baffles, or changing of some of the boiler fittings, may provide for greatly increasing the output of existing equipments. Where such simple means may be employed to increase boiler outputs by 10, 25, 50 or 100%, surely they are worthy of most careful consideration in these times of high costs, power shortage and slow delivery of new equipment.

If other or more extensive changes can result in still further increases of boiler capacity, these changes should be known and understood by both operating and designing engineers. It is well, also, to know what the theoretical limitations to capacity are and how close practice may be made to approach theory. This series of articles, dealing with such a timely subject, should be well worth the time required for their reading and study. The fuel and power problems will not be solved this winter or next, and sound reasoning should dictate that careful attention be given to every opportunity to increase the productiveness of the boiler room. Such attention is all the more necessary when there exists such an urgent demand for coal and for power.

Portable Electric Heaters as Coal Savers

Wherever surplus power is available, and especially where it is developed by water power, the present high cost of coal makes electric heating for early fall a most desirable arrangement. If it is possible to postpone the firing of furnaces for three weeks or a month, considerable will have been done towards alleviating the coal situation. In the main, during the early autumn, there are only certain hours in the day and certain rooms in the house that need heating, and this heating can be attended to promptly and economically by one or other of the various types of heaters on the market.

By use of the word "promptly" it is meant that an air heater will begin to affect the temperature of a room within a few minutes after the current is turned on, while a hot-water or steam furnace does not give results for at least two or three hours. Then, again, the extra heat is probably only required for a short time. With the electric heater the time of use is under absolute control, but with the furnace the heat continues to be delivered in many cases long after it is required.

Economically, the electric heater has much more to commend it than it had in the days when coal was to be obtained for $6 to $7 a ton. In those days it was considered that the cost of heating a home would be many times as much with electricity as with coal, but now that the price of coal is two and a half to three times what it was, the discrepancy in cost is much less marked. In the near future domestic electric heating will not be handicapped nearly so much by the cost of power as by the necessity for using all of the available power for other uses. In the meantime, however, where power is available, electric heaters offer an almost ideal arrangement for the early months of the winter season.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

WEST VIRGINIA UTILITY ASSOCIATION REORGANIZES.

Officers Elected at First Meeting Held Since 1917—Co-operation With Public Service Commission Advocated.

The West Virginia Public Utilities Association, which was inactive during the period of the war, has renewed its activities as evidenced by a meeting held in Charleston, W. Va., Oct. 5. One of the most important decisions of the conference was that embracing the maintenance of state headquarters permanently in Charleston and the employment of a paid secretary, who is to be appointed later. Tom Hays, Ohio Valley Electric Railway Co., Huntington, is secretary pro tem. The meeting discussed ways and means of co-operating more effectively with the state public service commission.

Officers elected are as follows: President, Herbert Markle, Appalachian Power Co., Bluefield; first vice-president, C. S. Billings, Wheeling; second vice-president, M. Hetzer, Moundsville Water Co.; third vice-president, E. W. Alexander, Charleston-Dunbar Traction Co.; treasurer, A. M. Hill, Charleston; executive committee, W. P. Hawley, Bluefield; C. C. Bosworth, Elkins; W. R. Power, Huntington; H. H. Grimsley, Clifton Forge; A. C. Babson, Charleston; H. S. Newton, Parkersburg; C. S. McCalla, Charleston, and C. H. Brewes, Wheeling.

HOLIDAY CAMPAIGN OUTLINED BY DEVELOPMENT SOCIETY.

Christmas Slogan of S. E. D. to Be Backed Up With Plenty of Assistance for Electrical Contractor-Dealers and Other Participants.

"Say Merry Christmas Electrically" is the slogan with which the Society for Electrical Development is launching the 1920 holiday campaign to help the industry make more sales. While the benefits of the elaborately outlined campaign will not be limited to S. E. D. members—the entire industry is invited to take part—the members will have the advantage of obtaining campaign material practically without cost.

One of the features of the campaign will be a five-piece cutout for window displays. The cutout is handsomely lithographed in five colors and will be adaptable to any size or shape of window. Fully illustrated instructions for making the most of the material will accompany the cutout.

Attractively hand-lettered invitations will be supplied to dealers to mail out to their customers and prospects asking them to visit their stores and see the display of electrical Christmas gifts. These will be printed in two colors on folded sheets of note paper, with envelopes to match. There will also be folders and booklets describing and illustrating many electrical gifts. The service includes lantern slides, poster stamps and 15 to 20 newspaper advertisements.

TECHNICAL SESSION OF A. I. E. E. AT PHILADELPHIA.

Economy of Secondary Distribution and Various Phases of Maximum Demand Measurements Are Discussed.

In a paper presented before the technical session of the Philadelphia meeting of the American Institute of Electrical Engineers, Oct. 8, P. O. Reyneau and Howard P. Seeley of the Detroit Edison Co. showed methods of arriving at economic designs of secondary distribution systems. The study as presented was carried forward from purely theoretical, a semipractical and from purely practical standpoints. Throughout the discussion, it was assumed that loading was uniform, and no allowances were made for the costs of right-of-way, poles, cross arms, insulators or some of the minor details. It was assumed that these items would be the same under any of the varying conditions considered. The conditions assumed were those of a residence lighting district. Numerous curves were presented to illustrate the solution of particular problems or parts of problems, but it was pointed out that general laws for the solution of such problems were not feasible.

In the solution of a definite distribution problem, it was assumed that a given district was loaded to a density of 8 kw. per 1000 ft. with No. 4 three-wire secondaries in place. It was assumed that the load would increase to 15 kw. in six years and that the drop in voltage should be limited to 3%. Two methods of handling the problem were chosen as follows: (1) Install 10-kw. transformers spaced 1000 ft. apart and replace them with 15-kw. transformers in three years; or (2) install 15-kw. transformers spaced 1500 ft. apart and change the spacing to 1000 ft. in two years. The method of figuring showed the first scheme to be less expensive by $33 per 1000 ft. for the six-year period.

A paper by Perry A. Borden entitled "The Measurement of Maximum Demand and the Determination of Load Factor" gave a general view of the present situation with regard to these two important items. For the purpose of studying demand, the subject was divided to give consideration to the quantity measured, the method of measurement and operation on various loads. In summing up the discussion of the first point Mr. Borden said:

"Since the true basis for demand measurement is an exceedingly evasive quantity, not capable of determination under practical work-

ing conditions, it is necessary that some compromise be made, and the nature of this compromise must be subject to local conditions and to personal opinions on the economic questions concerned.

"Tests would seem to indicate that, though volt-amperes cannot be said to be an exact representation of the quantity upon which demand would be based, they furnish us with a definite quantity whose value approaches nearest to the desired approximation."

Various types of meters and loads were discussed, and some of the characteristics of each were described. It was pointed out that, where heating is being taken into consideration, the logarithmic average is fully as justifiable as the arithmetical average for demand measurement.

ANNUAL NEW YORK ELECTRICAL SHOW POPULAR.

Well Attended by the Public and Keen Interest Shown in Household Equipment—Electrical Devices of All Kinds Displayed.

The thirteenth annual New York Electrical Show, held at the Grand Central Palace, Oct. 6-16, displayed labor-saving and housekeeping devices on a scale far greater than ever exhibited there before, and demonstrated developments in the use of electricity in home, office, store and factory. To illustrate the possibilities of substituting electricity for human labor in the home, a model household was set up in the main section and a large variety of machines operated. Among these exhabits showing the present stage of development were 21 types of washing machines, eight dishwashers, six iceless refrigerators, three kitchen mixing and beating devices, 17 vacuum cleaners, 12 ranges, and many broiling, baking and frying devices.

On the three floors were displayed 151 separate exhibits. The entire third floor was a working demonstration of the employment of electricity in a score of industries. One exhibit was on material handling, with industrial trucks, conveyors and hoists in operation. Among the processes of manufacture to be seen in actual operation were woodworking, furniture making, welding, japanning, heat treating, rivet heating, oil tempering and heating with vacuum furnaces. Complete processes were shown in a bakery, laundry, refrigerating plant, battery-charging plant, etc. The electrical novelties exhibited included a grass cutter, window washer, rug and carpet washer, electrical hair cutter, vibratory razor and a machine which bores square holes.

A display and demonstration which attracted many visitors was the device employing a cable excited with a high-frequency alternating current for guiding ships through channels in foggy weather, and a new radio compass or direction finder, which the Navy Department has installed in a number of stations along the Atlantic coast for the purpose of giving navigators off shore their exact location. Both of these systems are peace-time applications of devices invented during the war and kept secret up to this time.

The wireless telephone excited keen interest since reports of the world's baseball series were received over it. Its modern application is either between aeroplanes or for maintaining communication with the ground up to a distance of 10 miles. The show was well attended throughout and successfully demonstrated to the public what electricity is doing to reduce wasteful effort in the home and in industry.

Central-Station and Manufacturing Companies Have Interesting Exhibits.

The Brooklyn Edison Co. featured an appliance booth with each article displayed in a separate compartment, while the New York Edison Co. had exhibits of three bureaus. The automobile bureau displayed statistical charts and under the home economics bureau a model fully equipped laundry, pantry, kitchen and living room were shown.

The General Electric Co. showed in operation electrical industrial heat-application apparatus, as well as a control panel for charging electric vehicles. Factory lighting units and the latest in reflectors were also displayed.

The Westinghouse Electric & Manufacturing Co. had a display of household and labor saving devices on one floor and a motion-picture equipment and a studio light-control outfit on another.

An unusually spacious reception room for the comfort and convenience of guests was a feature of the United Electric Light & Power Co's exhibit. On each side of the parlor demonstrations of efficient and labor-saving domestic appliances were given. Among the new appliances exhibited were an electric vacuum washer that washes, boils, rinses and dries without removal of clothes from the machine; an ironer with the hot shoe under the rolls and directly above the gas flame; a heater that either heats, cools or dries; a portable machine that washes carpets and rugs and a lamp-socket-connected fireless cooker that roasts, broils, bakes and boils.

The New York & Queens Electric Light & Power Co. exhibited a model kitchen and dining room, both electrically equipped, with the apparatus connected by different colored wires to a power house shown above the two rooms.

The Western Electric Co. featured the five essential appliances for the home, namely, the clothes washer, vacuum cleaner, dishwasher, portable sewing machine and ironer. Electrical table cooking appliances were also displayed.

The Yonkers Electric Light & Power Co. exhibited modern household heating and cooking appliances, with a large variety of portable lamps, vacuum cleaners and laundry apparatus.

Others among the exhibitors were:

Albaugh-Dover Co., Alpha Electric Co., American Electro Technical Appliance Co., American Ironing Machine Co., Appliance Distributing Corp., Aqua Electric Heater Co., Baker R. and L. New York Corp., Balso Refrigerator Co., Bell Electric Motor Co., Berg Electric Car Co., Black & Decker Manufacturing Co., Bleadon-Dun Co., C. C. Bohn Electric Co., Charles A. Branston Co., W. A. Buerkle Sales Co., Chicago Fuse Manufacturing Co., Clothel Refrigerating Co., J. M. Collins & Co., Couch & Dean, Duparquet Hout & Moneuse Co., Disbecker & Co., Duplex Lighting Works, Edison Electrical Appliance Co., Elasticap Co., Electrical Alloy Co., Electrical Supply & Equipment Co., Electrical Review Publishing Co., Electric Storage Battery Co., Electrical Testing Laboratories, Eureka Vacuum Cleaner Co., Fairbanks Co., Federal Electric Co., J. B. Ford Co., Fox Electrical Corp., Frigidaire Corp., I. P. Frink, Inc., Gage Publishing Co., Gillespie Eden Corp., Golden Glow Sign Corp., Gould Appliance Co., Guarantee Electric Products Co., Habirshaw Electric Cable Co., Halliwell Electric Corp., Hamilton-Beach Manufacturing Co., Hamilton-Beach Carpet Washer Co., Wallace B. Hart, Hanover Electric Co., Hartt & Morison, Hanovia Chemical &

Manufacturing Co., R. G. Haskins Co., Home Device Corp., Home Helps Manufacturing Corp., Hoover Suction Sweeper Co., Hurley Machine Co., Isko Electrical Refrigerator Co., Kelvinator Corp., Kimball Electric Co., Lakewood Engineering Co., Laun-Dry-Ette Sales Co., Landers, Frary & Clark, Levien Electric Utilities Corp., Lightolier Co., McGraw-Hill Co., McIntosh Battery & Optical Co., Majestic Electric Development Co., Mallory Industries Corp., Manhattan Electrical Supply Co., Manning, Bowman & Co., Matthews Lighting Co., Metropolitan District of the New York State Association of Electric Contractors and Dealers, National Lamp Works of General Electric Co., New York Appliance Co., New York Electrical School, Ohio Electric Co., Pittsburgh Electric Specialties Co., Pittsfield Machine & Tool Co., Pneuvac Co., Premier Service Co., Regina Co., Remmert Manufacturing Co., Robin Lighting Fixture Co., Robins & Williams, Rutenber Electric Co., W. & J. Sloane, Thomas B. Snow, Terminal Engineering Co., Inc., Thermo-Fan Electric Co., William Truswell & Sons, Tucker Electrical Construction Co., Paul D. Vandevelde, Viking Sign Co., Ward Motor Vehicle Co.

COMMITTEE TO DEVELOP PLANS FOR UTILITIES COMMISSION.

The City Club of Washington, D. C., has appointed a committee to develop plans for the establishment of a local public utilities commission, entirely separate from the Board of District Commissioners, which now handles utility questions. The committee is composed of H. B. Plankinton, chairman; E. E. Williamson, W. A. Mellen, G. C. Ober and L. H. Warner.

WATER POWER LEAGUE CONVENES IN WASHINGTON.

Necessity of Conserving Exhaustible Natural Resources of Country by Using Water Power Urged—Government to Aid Projects.

That co-operation between government officials and the power industry may be definitely expected was prominently brought out at the convention of the Water Power League of America, held at Washington, D. C., Oct. 7-8. This was the first meeting of the league since the creation of the Federal Power Commission by Congress at its last session. In addressing the convention, O. C. Merrill, secretary of the commission, stated his purpose to lend every possible assistance to the development of national water-power resources, but with a proper regard for the public interest.

The convention was called to order by Prof. George F. Swain of Harvard University, president of the league, who urged the necessity of conserving the exhaustible natural resources of the country, such as oil and coal, by inexhaustible water power. This would also relieve the demand for labor and cars in moving fuel.

Mr. Merrill predicted that amendments would be made to the new law, but that its fundamental principles would endure. The federal commission is authorized to regulate rates, service and securities. Over 60 applications have already been filed, involving over 2,000,000 hp.

Lieut.-Col. William Kelley read a paper on "The Relations Between Navigable Waters and the Federal Water Power Act." He showed how the interests of power, irrigation and navigation are frequently in conflict. It is the function of the federal commission to adjust these conflicts.

At the session on Thursday afternoon, John A. Britton, Pacific Gas & Electric Co., told of the power developments in California and the vast projects now under way. He urged the power men to co-operate with the government under the new law. Alexander T. Vogelsang, Assistant Secretary of the Interior, spoke in complimentary terms of the new law.

At the Friday morning session Col. W. B. Greeley, chief of the U. S. Forest Service, discussed the power resources within the national forest, which amount to 16,000,000 hp., or about one-fifth of the total for the nation. Only about 650,000 hp. have been developed. He looks forward to further use in connection with such industries as pulp and paper making which could well be located in proximity to the forests and the available power. Col. Greeley told how water-power developments may proceed on land within the national forests, as permitted under the new law. The Forest Service will aim at the most complete and well-rounded development.

T. Kennard Thompson read a paper discussing the power problem at Niagara Falls. Here are the greatest power possibilities in the country, and development should follow some complete plan instead of being done on a piecemeal basis. He favors a dam 4 mi. below the falls, utilizing the 102-ft. drop in the river below the falls and Lewiston.

W. S. Murray, who has made a survey for a "super-power" scheme for supplying the industrial regions in the East, spoke at the closing session. A saving of $300,000,000 to manufacturers and railway companies would be accomplished by utilizing the power in rivers between Washington and Boston, he said. Creation of such a zone, with the accompanying electrification of railways and factories, would mean a vast saving of fuel. Most of the larger streams in the East are undeveloped and sufficient power is going to waste to supply all the factories and all the light needed in that territory. It will take many years to complete the projects, but the delegates were urged to work for it.

John W. Dorsey, University of Manitoba, presented a plan for the use of hydroelectric power for domestic purposes, including the heating of residences.

A banquet was held Thursday evening at the Hotel Washington, at which Edward Terrell, vice-president, was toastmaster. Addresses were made by Secretary Payne of the Department of the Interior; George Otis Smith, director of the Geological Survey; O. C. Merrill, executive secretary of the Federal Power Commission; George F. Swain, president, and Henry A. Lardner, New York.

PITTSBURGH SECTION OF A. I. E. E. HOLDS MONTHLY MEETING.

The monthly meeting of the Pittsburgh section of the American Institute of Electrical Engineers was held Oct. 12 in the auditorium of the Chamber of Commerce building, Pittsburgh. Philip L. Alger, General Electric Co., Schenectady, N. Y., read a paper on "Induction Motor Core Losses," which described certain results of a research carried on by R. Eksergian and himself at Harvard University and the Massachusetts Institute of Technology under the direction of Prof. C. A. Adams.

The principal results achieved by the research were: (a) New formulas developed for

the losses in the core back of the teeth, and multipliers established to be used with the formulas usually employed; (b) complete tests and calculations carried out on a smooth-core rotor and observed losses compared with expected results; (c) total core losses are from two to three times the fundamental frequency losses, it being indicated that tooth frequency core losses constitute from 0.5 to 0.66 the total in ordinary induction motors; (d) experimentally demonstrated that the hysteresis torque due to a revolving field breaks abruptly through zero at synchronous speed.

WESTINGHOUSE COMPANY ENTERS WIRELESS FIELD.

Controlling Interest Acquired in International Radio Telegraph Co.—Massachusetts Factory to Be Equipped to Make Apparatus.

The Westinghouse Electric & Manufacturing Co. has acquired a controlling interest in the International Radio Telegraph Co., and in the future will manufacture the radio equipment heretofore produced by the latter organization, which was founded by R. A. Fessenden, the pioneer investigator in the continuous-wave field. The Radio company operates and maintains wireless stations on ships, and has shore stations at Newport, New London, Brooklyn, Cape May, with others under construction in Maine and Massachusetts.

A new company has been organized under the same name, with a capital of $1,250,000 in preferred stock and 250,000 shares of common stock of no par value. The officers are Guy E. Tripp, chairman; E. M. Herr, president; S. M. Kinter, Calvert Townley and H. P. Davis, vice-presidents; John V. L. Hogan, manager. All of these are Westinghouse officials except Messrs. Kinter and Hogan, who were president and manager, respectively, of the older company.

The Westinghouse company will be interested in both the manufacturing and the operating branches of wireless telegraphy and telephony. A separate factory has been equipped at East Springfield, Mass., for the manufacture of all types of modern radio apparatus, from the largest transmitting and receiving sets required by transoceanic stations to the small sets used by the amateur. Apparatus will not only be supplied for the land, sea, ship, airplane, military and naval services, but special attention will be paid to the development of new uses, such as for railroads, power companies, mines, lumber camps, ranches and farms, and for inter-works communications of large industries. A staff of research and design engineers has been built up and important fundamental development work is under way.

MEETING OF ADEQUATE OUTLETS DIVISION, N. E. L. A.

The adequate outlets division of the advertising and publicity bureau of the National Electric Light Association met at the Statler Hotel, Cleveland, Oct. 7, with L. D. Gibbs, chairman, presiding. The gathering resolved itself into a discussion of the old problem of the sufficient number of convenient outlets and ways and means of bringing to the attention of the public the proper methods of using electric service. It is the intention of the adequate outlets division to reach all national advertisers and educate them in the correct manner of illustrating electrical devices and applying electric service.

In this connection J. C. McQuiston, Westinghouse Electric & Manufacturing Co., made a suggestion that instead of the circular letter which has been distributed in the past, that a code of practice be issued summarizing the material in convenient form and suitable for display in advertising agencies, advertising departments and such other places where display of electric service is apt to be encountered in advertising. It was planned to carry out Mr. McQuiston's suggestion.

WESTERN ELECTRIC CO. SALES MANAGERS MEET.

Optimism as to the prospect for an increasingly large volume of business prevailed at the quarterly meeting of sales executives of the Western Electric Co., held Sept. 30 at the Lotus Club, New York City. Among those in attendance were C. G. DuBois, president; H. A. Halligan, vice-president; H. F. Albright, vice-president and general superintendent; F. A. Ketchem, general sales manager, and six district managers. A noteworthy fact in connection with the conference was that the average age of the 19 executives present was 45 years, and the average period of service with the Western Electric Co. was 21 years.

CONTRACTOR - DEALERS DISCUSS BUSINESS OUTLOOK.

Trade Conditions Reviewed—Sales Experts Give Valuable Instructions—Profits in Fixture Business—Next Meeting in Buffalo.

W. Creighton Peet, chairman of the National Association of Electrical Contractors and Dealers, sounded the keynote for the ensuing year when, in his opening address at the annual convention at Baltimore, Oct. 4-9, he said that "the advancement of this already strong organization depends upon more complete co-operation." In commemoration of the twentieth anniversary of the founding of the association at Buffalo, N. Y., the twenty-first annual convention will be held in that city July 20, 1921. Chairman Peet reported a present membership of 2100, or more than double the number it was four years ago.

Thomas A. Whelan, president of the Fidelity & Deposit Co. of Maryland, with 7000 agents scattered throughout the United States, gave a most complete review of business conditions in an address on "The Industrial Outlook." He said that national and individual interest in the approaching presidential election was eclipsed by a desire to know the future of business conditions nationally, and to get information on this subject.

Mr. Whelan said that a building survey of the country, covering a period of three weeks, had just been completed by his company through the distribution of a questionnaire in 900 manu-

facturing and commercial centers, among bankers, manufacturers, wholesalers, farmers and chambers of commerce in an unbiased and nonpartisan manner. The results were classified and summarized by experts and divided into nine geographic divisions.

Confidence in Business Conditions Grows Stronger Daily.

Franklin K. Lane, former Secretary of the Interior, was shown the results of the Fidelity survey. He pronounced them as indicative that the United States is economically sound and better off than other countries. The country was shown to be on a sound basis with production increasing, with conditions improving and a growing feeling of confidence among dealers, jobbers and manufacturers. It was shown that there is no shortage of raw materials, that transportation has vastly improved and that the supply of labor is equal to the demand, without a material increase in cost. Credit, however, is tight, with money at 6 to 8% in the East, 8 to 10% on the Pacific coast and 10 to 12% in the Rocky mountain section.

The coal shortage, except in the South, is serious and the unsettled condition at the mines makes the outlook dubious. The demand for products of industry is reflected by booked orders, but dealers are carefully watching the buying of consumers. Mr. Whelan pointed out that the fall in prices anticipated a month ago is now taking place, and Dun's report for the previous week showed 7 declines to 10 advances, the largest increase in declines since the readjustment period began. Price declines here have had no unfavorable effect upon the farmers, but will be later reflected in lower prices to the consumer. The peak of prices has been reached.

"The average man is now concerning himself with practical economics," said Mr. Whelan in conclusion, "and is asking for a more direct system of distribution. Farmers favor co-operative effort as a means of relief from high costs, and the next few years is going to call for deep thinking and studying of the problem to solve it satisfactorily and permanently."

J. M. Wakeman, general manager of the Society for Electrical Development, related the activities of that society, which he said in no way conflict with those of the National Association of Electrical Contractors and Dealers. He praised the good work of those merchandising missionaries of the electrical field, W. L. Goodwin, Samuel A. Chase and H. B. Kirkland. The speaker called attention to the work of the society toward popularizing the slogan "Do It Electrically."

Special Traveling Representative Reports Activities.

During the past eight months L. W. Davis, special representative of the association, has visited electrical contractor-dealers of 96 cities in 28 states and Ontario province, Canada. His report noted a strong tendency toward unity and co-operation among dealers, resulting in cleaner competition, better stores and greatly improved merchandising methods, with a broader spirit of co-operation from the central-station companies.

Mr. Davis voiced a warning to every contractor to make certain of a profit on every job and not to be content with covering expenses during this "marking time" period. He also advised that every appliance sold should be an educational factor toward selling another and cited an example of the real spirit of co-operation needed between contractor-dealers and the central-station companies in a merchandising campaign to attract the public. Mr. Davis questioned the justification of the contractor-dealer who becomes a distributor or jobber of electrical construction supplies, or the jobber who becomes a contractor, and urges serious consideration of the question.

The traveling representative argued against free trials of electrical appliances and urged more uniformity of contracting work by the dealers. Admonition was given the dealers to guard their credit standing by conducting their business along safe and business-like lines.

In his discussion of the subject, "Proper Handling of Lighting Fixtures," J. L. Wolf, secretary of the Lighting Fixture Dealers' Society of America, said that the greatest pitfall in the fixture business today lies in not arriving at the right cost, usually through failure to figure sufficient to cover cost of labor. It was pointed out that there are three distinct classes of business for the fixture dealer today: First, commercial, which includes fixtures sold at prices suggested by the manufacturer; second, medium-class residential fixtures which come ready to install, and should be marked up 100%; and third, high-class, which are heavy and expensive, ready-to-install types, and should be marked up 150%. Several manufacturers of special types of fixtures gave demonstrations of their products and added to the general information regarding merchandising.

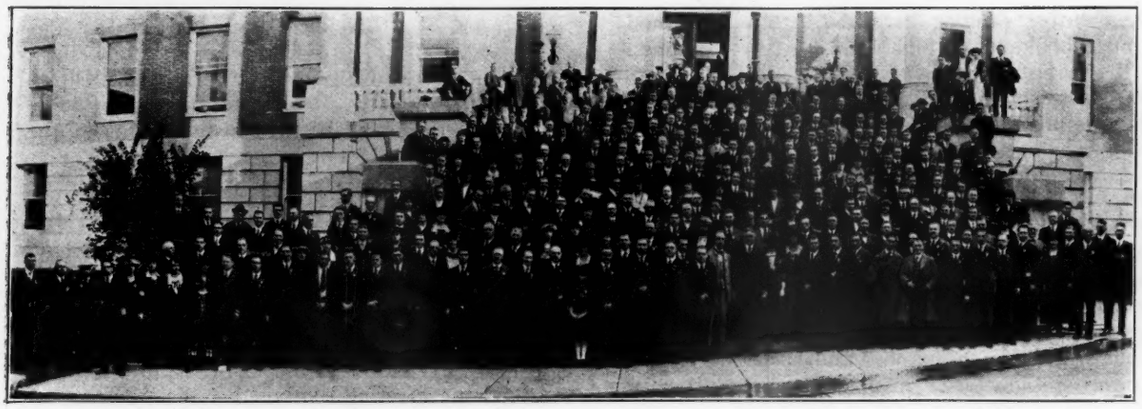
Profitable Angles to Contracting Business Outlined.

A. L. Abbott, Electric Construction Co., St. Paul, Minn., in a paper on "Managing an Electrical Contracting Business," advised that the administration of an electrical contracting business can be divided into three departments—sales, executive and accounting—which should be under one head. He urged that all employes should receive a bonus as it tends to hold the organization together, develops better efficiency and increases the output. Electrical contractors were advised to subscribe to trade papers and read them regularly and thoroughly.

"There is room for vast improvement in the manner of handling contracting work," said Mr. Abbott. "If you would succeed, know what you want. Make plans to get it. Use the best methods. Keep the organization inspired with the spirit of success and don't think that you know it all. Service is furnishing to your customer what he should have. The small contractor should specialize, and a successful business must have definite plans to expand along healthy lines. Sudden expansion means confusion and inefficiency. Sudden contraction means excessive overhead. Preserve a proper balance between the organization and the work."

The discussion which followed Mr. Abbott's paper brought forth a number of bonus plans in present use, and an explanation of their methods.

M. H. Aylesworth, executive manager of the



Group of Contractor-Dealers and Visitors at the Baltimore Convention of National Association of Electrical Contractor-Dealers, Oct. 4-9.

National Electric Light Association, in discussing "What the N. E. L. A. Is Doing to Help the Contractor-Dealer," said that his organization was trying to get the dealers and central-station men to meet on common ground and discuss their problems. He said that at present the situation was getting ahead of the industry, with 14,000,000 homes to be wired and 450,000 houses to be built. In conclusion he urged any contractor-dealer who found a central-station company any place in the country not playing fair with him, to write the N. E. L. A.

J. J. Muldaur, National Board of Fire Underwriters, appealed for the co-operation of contractor-dealers in the work of reducing the $22,000,000 worth of property destroyed last year through electrical causes. This can be done by using only approved devices, the speaker stated.

Expert Merchandisers Give Instructive Talks and Demonstrations.

H. B. Kirkland, of the American Wiremold Co., employed charts and figures to make more impressive his talk on "A Two Billion Dollar Industry." He estimated that the 1921 volume of sales of electric machines, vacuum cleaners, fans, flatirons, sewing machines, dishwashers, washers and wringers, wiring devices, etc., would total approximately $2,000,000,000. "Therefore," aid Mr. Kirkland, "this branch of the industry requires careful and proficient sales management in order to derive the full profit and continue its development."

When Samuel A. Chase, Westinghouse Electric & Manufacturing Co., addressed the convention on "Harmonizing the Industry," it was his first appearance before the association as an honorary member. He called attention to the wonderful changes that had come over the industry during the past few years, resulting in the developing of harmony and co-operation and carrying out his slogan of "Live and Let Live." He complimented the contractor-dealers on their enthusiasm and hard work, and the manner in which they arranged merchandising meetings in various parts of the country for W. L. Goodwin and himself to address.

"Can the contractor-dealers in convention justify the creation and building up of a retail structure which compels a gross addition to overhead of 166% in order to make a profit?" asked W. L. Goodwin, of the General Electric Co., in his talk on "Scientific Merchandising." Continuing, he said: "If such a margin is necessary, then the quicker the retail business is dropped the better. Distribution must be conducted economically or another system instituted. There is need of a reasonable margin of profit to give high-class service. The final proof lies in whether you can perform economically or not, and when the economic law begins to work the inefficient ones will fall by the wayside. The real job before the association is to train every member in that ability which permits him to conduct his business properly and efficiently. We can never set up conditions which will allow careless and indifferent managers to conduct a business at a profit."

Modern Methods of Industrial Lighting Discussed and Demonstrated.

Ward Harrison, National Lamp Works of General Electric Co., utilized an elaborate demonstration of industrial lighting during the presentation of his subject, "Seeing Is Believing." For that purpose the session in which it was presented was adjourned to a specially prepared room which had been fitted up with lamps and reflectors of semi-modern and the latest types, the circuits of which were controlled from a central switchboard.

Mr. Harrison's demonstrations brought out the value of reflectors in regard to comfort and increased illumination. The inadequacy of some state code requirements was illustrated. It was demonstrated that better lighting means better vision, that proper direction of light aids better vision, that some shadow is advantageous and that a bright light near the line of vision greatly reduces one's ability to see detail. Results of investigations were used to show that higher illumination helps the sub-normal eyes more than the normal, and for maximum efficiency the units of every lighting system should be kept clean through a regularly instituted maintenance service.

In his presentation of the subject, "The Industrial Lighting Market and the Contractor-Dealer's Part in Selling It," P. B. Zimmerman, publicity department, National Lamp Works of General Electric Co., stated that a survey of eight states showed that 60% of the industrial plants needed improved lighting systems. He said that the contractor-dealer, in order to sell

intelligently, should become better informed through booklets of valuable information supplied by the manufacturer without cost. Mr. Zimmerman divided the lamp field into sales for industrial, commercial, home lighting, farm miniature and miscellaneous purposes.

R. W. Shenton, Cleveland, whose subject was "A New Era in Lighting," stated that insurance statistics show one of every 40 accidents in industrial plants to be due to inadequate lighting, and that in many instances production has been increased 20 to 25% by changing the standard of lighting. "Illumination is an investment for profit," said Mr. Shenton, "and there are opportunities for increased business in all branches of the lighting industry."

A. D. Page, of the Edison Lamp Works, said that since the development of more efficient illuminating, lamps have become the recognized "sugar" of the merchandising business.

William A. Thomson, bureau of advertising, American Newspaper Publishers' Association, in a talk on "Advertising for the Contractor-Dealer," said the advertisements of electrical manufacturers have dealt too much in generalities and are "over the heads" of the average consumer. He advised the dealer to advertise intelligently and get the manufacturer to do likewise.

In a discussion on the handling of lighting fixtures J. V. Netter, Lightolier Co., New York City, explained the benefits of the sales methods of his company to the contractor-dealer. E. C. White, Electric Outlet Co., New York City, demonstrated a flush-type outlet soon to be placed on the market by his company.

"The Sale of Motors for Industrial Use," was the subject of an instructive talk by J. H. Clark, Westinghouse Electric & Manufacturing Co., who advised that contractor-dealers should employ a salesman to specialize on motors. This paper was discussed by G. M. Wheeler, Maintenance Co., New York City.

SCHEDULE OF MEETINGS FOR IRON AND STEEL ENGINEERS.

Papers scheduled for the Cleveland District section meetings of the Association of Iron and Steel Electrical Engineers, for the season of 1920-21, include the following:

Oct. 11, "Troubles of the Electrical Operating Man," by A. W. Mohrman, assistant electrical superintendent of the Trumbull Steel Co., Warren, O.; Nov. 8, "Slip Regulators Versus Notchbacks," by Gordon Gage, chief electrician of the American Rolling Mill Co., Middletown, O.; Dec. 13, "Continuous Rated or 50-Deg. Rise Motors," by L. F. Adams, electrical engineer of the power and mining department, General Electric Co., Schenectady, N. Y.; Jan. 10, "Proper Selection of Carbon Brushes," by L. A. Heath, engineer of the Morganite Brush Co., New York City, and John S. Cavitt, sales manager and secretary of the Electrical Engineering & Manufacturing Co., Pittsburgh; Feb. 14, "Scientific Combustion Control for Boiler Furnaces," by M. G. Benjamin, of the Benjamin Engineering Co., Cleveland; March 14, "Electric Propulsion Ships," by W. E. Thau, electrical engineer of the general engineering department of Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; April 11, "Electrical Cleaning of Gases as Applied to Blast Furnaces," by N. H. Gellert, president of the Gellert Engineering Co., Philadelphia.

The meetings will be held in the rooms of the Electric League, Hotel Statler, Cleveland.

JOBBERS' REPRESENTATIVE AT NATIONAL LAMP WORKS.

Representatives and salesmen of the National Lamp Works of General Electric Co. held a three-day get-together meeting recently at Nela Park, Cleveland. Enthusiasm and interest marked the meeting of the "B" agency distributors, and while some of the guests had never been at Nela before, they soon got the spirit of the place and entered into the work and play with as much pep and vim as the veterans who had attended many similar conferences. The National furnished nine speakers and Duplex another, Guy Norton. Nela Park men who talked to the distributors included J. E. Kewley, who opened the meetings, W. G. McKitterick, R. W. Shenton, Ward Harrison, W. M. Skiff, Earl A. Anderson, T. K. Quinn, H. H. Magdsick and P. B. Zimmerman, who gave the final tie-up talk of the intensive three-day program. Outdoor sports in Nela Camp, baseball and tennis, etc., and indoor sports, added variety to the meeting by employing the odd hours pleasantly. It is anticipated that tangible results in a further extension of the religion of better light will follow this big jobbers' convention.

NEW YORK SOCIETY HEARS TALK ON SUPER-POWER ZONE.

W. S. Murray, chairman of the super-power survey organized by the United States government, spoke before a meeting of the New York Electrical Society Oct. 7. He gave the objects of the survey, which are to allocate the amount of waste within the eastern zone, due to the present improper form of power production and distribution, and to recommend a regional plan through which the objective could be attained. The proposed regional plan includes the building of central stations at tidewater and at mine mouths, supplemented by such hydroelectric developments as will be economically within the reach of the zone. All of these stations would be united through a main trunk transmission employing high voltage, and there would be included in such a unification all of the large central stations at present in existence in Boston, Providence, New York, Newark, Philadelphia, Baltimore and Washington.

INVESTMENT PLAN FOR EMPLOYES OF WESTERN ELECTRIC CO.

Among the subscribers to the recent issue of five-year 7% convertible gold bonds issued by the Western Electric Co. were 4,574 employes representing investors in each of the 42 branches of the concern. They have applied for securities aggregating approximately $2,000,000 par value. The sale to the employes was made under an installment basis.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

EARNING COMMISSIONS BY SELLING ELECTRIC PHONOGRAPHS.

Employes of the Commonwealth Edison Co., Chicago, are being given an opportunity to earn liberal commissions by inducing their friends to purchase a Federal electric phonograph. For every prospective customer who consents to have a representative of the company call, and where a sale is made, the employe will receive a commission of $3.50. Credit will only be given, or a commission paid, where the Edison employe sending in the necessary printed slip has actually talked with the "prospect" and received permission to have a company representative call. This commission plan merely requires the employe to set forth the advantages of having one of these electric phonographs in the modern American home.

CUSTOMER-CO-OPERATION SOUGHT THROUGH ADVERTISING.

Milwaukee Electric Railway & Light Co. Advising Its Customers of Real Situation by Means of Local Newspapers.

The Milwaukee (Wis.) Electric Railway & Light Co. is using the local newspapers to acquaint its customers with the problems which it faces. An extract from one of the advertisements is given herewith:

Milwaukee faces a tie-up. Twenty per cent reduction in use of electric service by all customers is the only thing that can avert it. Frequent and prolonged stopping of streetcars during rush hours and costly interruptions of factory operations and all other electric service will be unavoidable in spite of anything the electric company can do unless each light and power customer immediately reduces his use of electricity 20% between the hours of 7:00 a. m. and 7:00 p. m. Since the company first advertised this situation on Sept. 17 a reduction of 4% in total use of electricity between 7:00 a. m. and 7:00 p. m. has been obtained through the prompt and public-spirited co-operation of a minority of our 80,000 customers.

Their co-operation is keenly appreciated. We feel sure that others, when they grasp the vital necessity of similar action, will also help us to keep the cars running and the factories operating regularly during the next three months, until we can get the first 20,000 kw. of electricity power from our new Lakeside station. We realize, of course, that many users of electric service need time to readjust their operations, so as to either reduce actual consumption of power, or to transfer their use of it to the hours between 7:00 p. m. and 7:00 a. m. During those hours there is plenty of power for all who want it.

We are up against the same conditions that handicap electric central stations in many of the larger cities at this time. Rapid growth of war industries enormously increased the demand for electric power. Rapid growth of cities greatly increased the demand for electric service. The war stopped the expansion of power-producing facilities. Since the war's end permitted such work to be financed, even though on a costly basis, we have been working day and night to get our new power plant ready for service. The first generating unit, of 20,000 kw., is expected to be producing within three months.

Meanwhile, our producing plants have only been able to meet the demand laid upon them with the aid of customer-co-operation, and the exceptionally favorable weather which has prevailed up to this time. Even if we had good coal the plants would be unable to meet the full demand. The best coal we can get today costs us over three times what good coal used to cost and it produces 15% less energy. Our power plant men, working in three eight-hour shifts, are getting more power out of the old plants than their rated capacity with the coal now available. This, however, is not nearly enough. When, at any hour, actual demand for energy exceeds the supply, some car line or some factory, or group of factories in a given district, have to be cut off. With the poor quality of coal, there is no telling just how quickly such interrupted service can be resumed. Unless all customers will help save the situation by voluntarily reducing their use 20% between 7:00 a. m. and 7:00 p. m., frequent and costly tie-ups of cars and industries will be unavoidable.

The electric company does not wish to be compelled to discriminate between its customers. By getting the co-operation of all, as here requested, we should be able to serve all alike—20% below normal use—until our new plant's output can be utilized. We are confident the people of Milwaukee and other communities we serve will co-operate with us to meet this emergency. In any event, we shall not adopt the only alternative method of saving the plants—that of cutting off service at the power houses when the load exceeds the capacity—until we shall have exhausted all other means of procuring the readjustment of use that will permit continuous service.

CREATING INTEREST IN ELECTRICAL HOUSEHOLD APPLIANCES.

The accompanying illustration depicts an exhibit of the Topeka Electric Co. at the "Kansas Free Fair" held recently in Topeka, Kan. One of the striking features of the exhibit was a turn-

Exhibit of Topeka Electric Co. at the Kansas Free Fair.

table (shown at the right-hand side of the picture) which created a great deal of interest because of the fact that it was continually in motion and carried a well-arranged display of some of the smaller electrical household appliances.

To help create interest, the Topeka Electric Co. held a bean-guessing contest, giving two

prizes, the first being a $25 percolator and the second a $10 flatiron. This served the purpose of getting an electrical census and a prospect list, as well as attracting people to the booth. The contest card listed the names of all types of household appliances and had room for the name and address of the contestant, following which was the list of appliances with the phrase, "I have the following household appliances in my home" heading it. Squares were provided after each item to check the device. During the week there were secured the names of approximately 6500 people, 4000 being inhabitants of Topeka. The electric company considers the exhibit to have been a complete success.

EDISON CLUB HOLDS FIRST MEETING OF SEASON.

The Edison Club, composed of employes of the Commonwealth Edison Co., Chicago, held its first gathering of the 1921-22 season Oct. 12. Samuel Insull, president of the company, spoke in an optimistic vein as to the future of the public utility business, and referred to the fact that utility securities are coming more and more into favor with the public for investment purposes. Prizes and cups for various individual and team achievements were presented by Mr. Insull. An illustrated review of the club's activities during the past year was given by William A. Durgin, president of the organization.

PROMOTING GOOD-WILL AMONG CUSTOMERS AND PUBLIC.

Edison Electric Illuminating Co. of Boston Injects Sentiment Into Business Relations With Customers—Efforts to Improve Service.

The Edison Electric Illuminating Co. of Boston has been utilizing the advertising columns of the daily press quite extensively to acquaint the public of the service performed by the company. An open invitation has given to its customers to uncover their grievances and to advise the company of its shortcomings, as well as to offer suggestions which would help improve the service. In other words, the Edison company has been trying to "see itself as others see it," and desires the public to know that it is doing its best to serve the best interests of all concerned.

The company is injecting some sentiment into its business and trying to cultivate public confidence which follows when fair action is taken after a mutual understanding of the facts in a transaction. This confidence is the basis of business success. Failure to win the confidence of the public can be brought about by wrong fundamental company policy, or through the wrong attitude of the employes. "Policy" is a very large question, but because the making of it is centered only in the management, an adjustment is more readily obtainable. The attitude of the employes and the carrying out of the company policy are also large subjects, and the more complicated because relationship between public and employe is dependent on the hundreds of Edison representatives dealing in some way with the public.

The statement is made that some of the employes may or may not reflect the true policy of the company; one may be discourteous; one may not be friendly; and every breach of policy means a drop in the asset of good-will. It is therefore necessary to "jack up" every little while. The company states that it is its daily duty to bear in mind that "the Friendly Glow" promotes good-will and asks the question whether each individual is doing his best to live up to that standard. "The Friendly Glow" radiates a welcome to customers, with smiling countenance followed by courteous service.

ADVANTAGE OF LOCAL INVESTMENT IN UTILITY STOCKS.

Discussing the recent large buying by people of moderate means of securities of their home utilities companies, Adam Gschwindt, general manager of the Rockford Electric Co., says that the opportunity being offered provides not only a safe place for investment of savings and the sharing of profits, but also means much to the communities.

"The partnership is one which has its mutual advantages," says Mr. Gschwindt. "The man, woman or child who becomes a stockholder gains by receiving dividends from a well-established business with a steady and growing demand for its service. The company gains a more cordial interest in its affairs and a better understanding of what a well-managed public utility means to the life and future growth of the city. The city gains because the money comes back to it in the way of extensions and additions to property, providing greater facilities to keep pace with the growth of the territory served. That means that more industries will be attracted to it, thereby increasing general prosperity."

CITIES SERVICE CO. STOCK WELL TAKEN BY EMPLOYES.

The recent offering to employes of 6% cumulative preferred stock of the Cities Service Co. of New York City was well taken, 11,519 shares being subscribed for by 2775 employes, of whom 2347 had not previously been stockholders. Approximately 5000 employes are stockholders in the company at the present time. According to officials of the company, the number of holders of the banker shares is steadily increasing. The distribution of Oct. 1 was made to 12,810 holders, compared with 12,221 on Aug. 15, and since Jan. 1 there has been an increase of 7272 in the number of holders.

CONSUMERS' CO. ASKS INCREASE IN RATES.

The Consumers Power Co., of Grand Rapids, Mich., has applied to the city commission for permission to change from its present combination rate based on connected load plus an energy charge, to an 8-ct. straight rate. The company contends that the straight rate will be better understood by its consumers. The new rate asked will give an increased return in addition to simplifying the schedule. Other rate changes under consideration involve revisions in the present combination rate.

OPERATING PRACTICE

Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

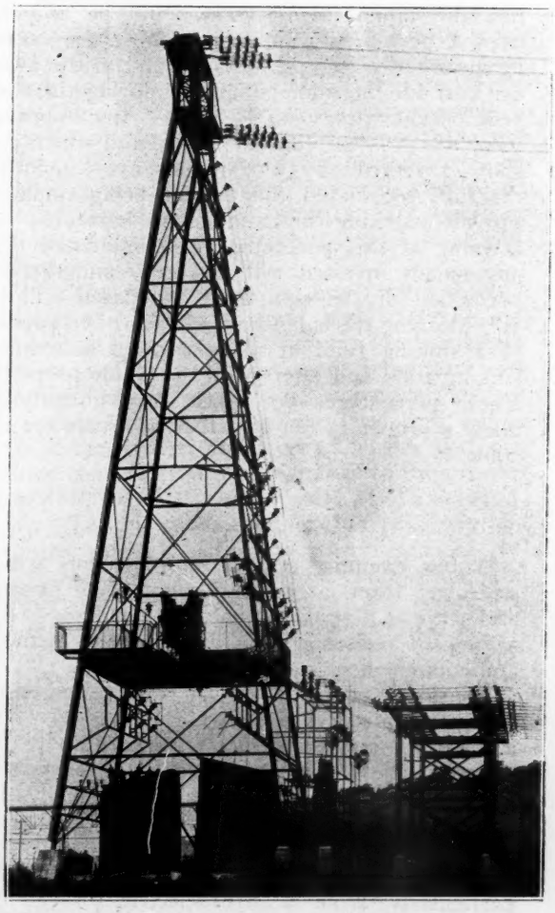
OUTDOOR SUBSTATION OF UNIQUE DESIGN.

Transformers and Switches Are Mounted Under and on the Tower Structure Supporting Transmission Span.

By R. E. ANDERSON,
Designing Engineer, Delta Star Electric Co., Chicago.

Increasing load demands made it necessary to install a 13,200 to 66,000-volt step-up transformer station to supply a 66,000-volt three-phase line on the opposite side of a wide river. To accomplish the desired result, the installation shown in the accompanying illustration was designed and erected. This installation is unique in that advantage was taken of the river-crossing tower to afford space for the step-up substation equipment.

At the tower base is a housing in which are installed two 13,200-volt automatic-overload oil switches, the 66,000-volt automatic-overload oil switch being mounted on a steel grating built into the tower. The 66,000-volt connections are carried down the outside of the tower on bus-bar supports, and are connected to a set of GPM, 66,000-volt, 200-ampere, three-pole, remote-control, air-break, disconnecting switches controlled by a common handle near the ground. From these switches connections run straight down through another set of GPM switches to an electrolytic lightning arrester, and from the bus connecting the two sets of switches taps run through choke coils to the high-tension automatic oil switch. From the high-tension oil switch, connections are made to the two 3000-kv-a. banks of transformers through single-pole disconnecting switches so arranged that either bank of transformers may be "killed" without shutting down the other.



Transmission Tower With High-Tension Substation at the Base.

The 13,200-volt transformer connections are carried into the housing where the automatic oil switches are located. From these switches the leads are brought out to the 13,200-volt switching structure at the left, each transformer bank being supplied by a line looping into the station. The transformers and line are connected with the bus through three-pole, double-break per phase, switches controlled from ground level. Each transformer bank is protected on the low-tension side by an electrolytic lightning arrester connected through single-pole disconnecting switches.

This installation is a good example of utilizing unit-type equipment to best advantage both as to cost and application. For example, by using type GPM remote-control 66,000-volt disconnecting switches it was possible to place them high up on the tower above the arresters and 66,000-volt oil switch. Had ordinary single-pole disconnecting switches, operated by means of a hook stick, been used, it would have been impossible to reach them.

RESULTS DEPARTMENT INCREASES STATION EFFICIENCY.

Extracts From Paper Read Before Station Operating Committee of Ohio Electric Light Association.

By T. J. NOLAN.

No doubt the greatest contributing factor in increasing efficiency of operation has been the "results" department. This department consists of a "results" engineer and assistants, and comes directly under the direction of the superintendent of production. By the reports and suggestions of the department the superintendent can determine and direct the best method of operation for the plant. It is also up to the "results" engineer to look after and make all tests, check and calibrate all instruments, analyze and keep a check on all coal burned, take ash samples and analyze

and work out all difficult problems which may come up from time to time whereby higher efficiency may be attained in the operation of the station.

The results department has also started to analyze electric losses in the station, and it has been a big surprise to find that the conversion losses are so enormous. The "Electric Data Sheet," which is compiled daily, shows the input and output of the different synchronous equipments, and by following the sheet closely a large saving can be made by keeping just enough machines in service to pull the load. That is, let each machine handle a little overload in preference to an underload.

The Water street station boiler room is unusually well equipped with instruments for the guidance of the boiler operators. Previously, the operation was mostly guess work as it is now in many plants. What seems to be the trouble in many places is that the operators either do not yet know of the existence of the kind of operating guide which will help them to get better insight into what is going on in their plants, or they are unfamiliar with the application of the existing apparatus to their particular needs. It might be mentioned in this connection that the production and care of these instruments is a branch of engineering requiring for its personnel some of the highest qualifications that an engineer can possess. In passing from this subject, I think that the first large contributing factor in modern station operation is a properly conducted "results" department.

REDUCED OPERATING EXPENSE AND INCREASED FIXED CHARGES.

Extracts From Paper Presented Before the Annual Convention of Indiana Electric Light Association.

By GEORGE A. NEAL.

The electric utility has built its business upon its ability to save its patrons personal labor, and the growth of the business is a testimonial to the value of the service. Analysis of its own service, therefore, advises that there may be latent possibilities for better operating results to be achieved by the adaptation of new labor saving methods and equipment to overcome present difficulties.

It is doubtful if there is any electric company that cannot reduce its operating expense by the use of the most modern station equipment, large units, underground distribution or high-voltage distribution. Accompanying any change is the matter of new investment bringing with it new interest charges. The question of what shall be done always resolves down to a comparison between present cost versus new costs plus interest and depreciation charges. Prudence demands that expansion without increased revenue be very carefully planned and considered. In the past when comparing the relation between machinery versus hand production, the curves of investment and labor were so straight that a correct relation could easily be determined by a competent person. This relationship could be considered as reasonably fixed over a long range of future years. But today the equipment cost and the wage rate, although tending to follow competitive channels, are inflated, and popular opinion maintains that both will be subjected to great declines in the near future.

INVESTMENT MUST PAY DIVIDENDS UNTIL RETIRED FROM EARNINGS.

An investment once made is permanent until retired out of earnings, and the fixed charges auxiliary to the investment must be met. If money is invested in equipment based upon operating economies obtained with the present labor scale and labor efficiency, the present margin may be maintained throughout the life of the equipment or the immediate benefits may be wiped out by a change in labor rates. Upon the solution of future labor costs, therefore, rests the decision regarding improvements.

Using the experiences of former wars as a measure, and allowing for the prospects of great shortages in crops, houses, ships, and all utility facilities, which must be overcome, it appears reasonably sure that all forms of labor will be in great demand for three and perhaps five years more. This demand should decline on the average from year to year. During this same time the cost of material and labor should slump gradually with the demand. During this interval and probably for some additional period, or until 1930, the curve of costs should descend slowly towards pre-war values.

With this outlook any large investment should be retired within a short time, or as an alternative the capital investment should be reduced over a period of approximately three years by means of a 33.33% sinking fund to the average cost for the same equipment during the five-year period from 1914 to 1919. Any improvement which is for continuous use and which can show a return of 33.33% per year should be carefully considered, this amount being ample to provide a sinking fund and a suitable return. In arriving at this percentage it is estimated that any money invested will cost 10% and the depreciation of the equipment purchased will be 10%, leaving the balance of 13.33% to be applied to a sinking fund or to be divided between a sinking fund and interest on the whole property. These percentages are taken very liberally to allow a proper factor of safety to insure the income.

IMPROVEMENTS MAY WARRANT INVESTMENTS TO REDUCE COSTS.

A few examples of the improvements which will often show large returns may be of interest and serve as a guide in analyzing conditions with a view of reducing costs through new methods and equipment.

Consider a utility which has sufficient capacity, but is operating with a high ratio between cost and income and with costs which are above the average. The following proposals are suggested:

(1) Can the station load be combined with other loads, either utility, traction or industrial, and one station be closed down? Is it possible to buy power from a reliable transmission system, particularly from a hydroelectric source? If feasible, can the station be salvaged and the money so received be made to cover the cost of

proposed improvements? This plan of action has been and still promises to be one of the most profitable procedures.

The solution of this type of problem has often been the salvation of the small-town central station, and is now becoming the goal of many companies supplying towns having a population of even 20,000 to 50,000 people. In almost every situation where combinations are possible the concentration of loads into one plant is the economical thing to do, and the final net revenue more than compensates for the increased fixed charges.

(2) The average electric utility endures a loss of "unaccounted-for current" varying between 10 and 25%. With present bus-bar costs varying from $0.01 to $0.04 per kw-hr. the value of such lost current has become one of the big items, in fact, next to coal it is the largest item in the budget. Allowing for reduced capacity throughout the entire system from the generator to the consumer's meter, this factor measures greater than is apparent upon the expense sheet. It is possible in some situations to reduce this so-called line loss sufficiently to provide for one or two years' growth without generating additional current. In general, this is managed by the use of high distribution voltages, especially for transmitting the bulk of the load, and by improved loading of distribution and station transformers.

(3) The cost of handling coal and ashes is usually the largest single labor item around a station. The class of help, the urgency with which it is always needed and the fact that such labor, which is highly competitive as to rate, is the basis for all rates in the station, all combine to recommend the use of genuine labor-saving machinery especially adapted to the work. Locomotive cranes, conveyors, industrial railroads, coal crushers, elevated trestles and overhead bunkers are the most prominent items to be considered.

(4) The reduction of flat water rates through the use of large turbo units, high vacuum, high superheat, high-pressure steam and electric-driven auxiliaries become more important with the high price of coal. The coal price bids fair to remain excessive for a long time, and will be one of the hardest and most expensive obstacles to overcome if future rates return to the pre-war basis.

(5) The improvement of boiler efficiency and capacity through better and larger furnaces giving large capacity and better combustion, and through the use of economizers, is a companion to reduced steam consumption in the engine room.

(6) The placing of important parts of the distribution system underground to reduce maintenance and interruption costs, and to insure services and earnings, is becoming very important in the large cities.

(7) The change from the old type of arc-lighting systems to incandescent systems with simplification of equipment and operation can usually be demonstrated to be an economical change.

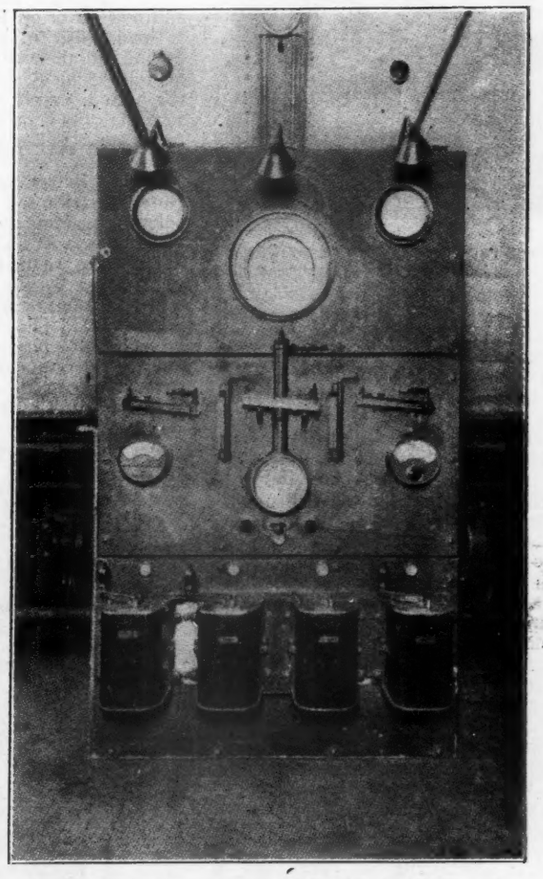
The above suggestions are offered as those most readily considered and can be greatly extended and detailed after a careful analysis of each part of the electric system.

CONTROL BOARD FOR OPERATION OF LARGE BOILER.

All Indicating Instruments and Regulating Devices Are Mounted Together on a Panel for Each Boiler.

Modern boiler-room practice involves a most careful control and regulation of each unit in operation. The accompanying illustration will serve to give an idea of the manner in which the Detroit Edison Co. equips the various boilers in their plants to give the firemen the greatest opportunity to know and regulate operating conditions. The board and equipment shown is provided for the regulation of a single boiler.

The controllers shown at the bottom of the board serve to regulate stokers, blowers and clinker grinders. A Euhling CO_2 recorder is mounted at the center of the board with a steam-flow meter immediately above it. Saturated and superheated-steam gauges are mounted at either side of the flow meter. The five draft gauges indicate draft pressures under the fire, over the fire and at the damper on each breeching connection. The tachometers show the speed of the stokers, and the switch below the CO_2 recorder is for the control of the damper-operating motor. This board is so convenient, and gives such information to the fireman, that he is enabled to have almost absolute control over his unit.



Boiler-Control Panel Used by Detroit Edison Co.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

Tapes for Various Insulating Purposes.

Tapes of various kinds have been used for insulation purposes for a long time because of their facility of application to the irregular shapes of coils, cores, etc., upon which it would be difficult to place insulation in sheet form. These tapes are either woven from

Insulating Tape Being Applied by Special Machine.

fibrous materials, and are known in such case as stays, or webbings, or they may be cut from treated or untreated fabrics. The General Electric Co., Schenectady, N. Y., will soon place on the market a complete line of such tapes, including several varieties cut from black or yellow varnished or oiled cloth. These tapes will be adaptable for winding armature or field coils, transformer coils, etc.

The ordinary white cotton tape has selvaged edges, an open structure, smooth surface, and medium strength, and may be used to tape armature coils to form the base for varnish. Asbestos tape contains a small percentage of cotton to facilitate the spinning of the yarn, and is adaptable for use with windings where heat-enduring insulation is required.

Another class of tape includes what is known as friction or splicing tapes. These tapes are usually used to cover joints which are exposed when splicing or connecting conductors. One type, known as splicing gum, is an all-rubber compound containing no cloth, and is made from fine para rubber. At ordinary temperatures the heat of the hand is sufficient to cause the tape to unite forming a solid and water-tight joint. Gum-faced tape is made of a layer of 98% pure rubber on a backing of unvulcanized high-grade rubber compound containing only fine para. It is valuable for taping joints on underground rubber-covered cables or in other places where high insulation and tightness against water is necessary. Joints made from this tape may be vulcanized if desired.

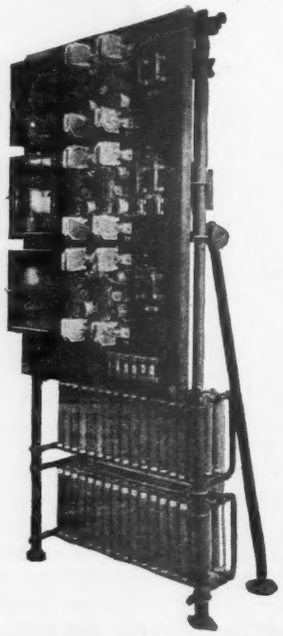
Temporary-binding or friction tapes are made of an unbleached cotton cloth, coated and filled with either black asphalt or rubber compounds. They are slightly adhesive at room temperatures and form excellent temporary bindings for ordinary purposes.

Electric Shoe-Sole Dryer.

For use in the finishing rooms of shoe manufacturing plants, where it is necessary to dry cemented soles or shoe bottoms, the S. U. E. Co., 89 Beach street, Boston, has brought out an electric dryer which is in the form of a low table with an electrical heating element incorporated in the upper surface. The heating element is controlled by a three-heat snap switch, giving 2000 watts on high heat, 1000 watts on medium heat and 500 watts on low heat. The dryer is made also in a double-deck form, having another dryer with a separate heating element mounted 18 in. above the bottom dryer.

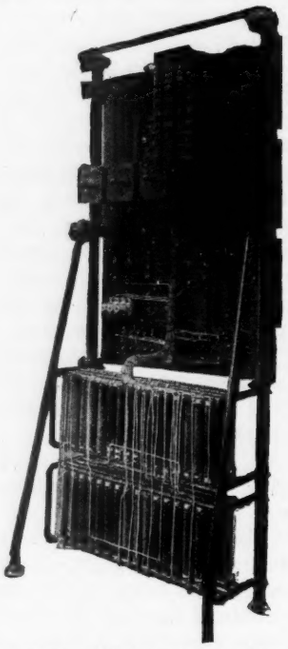
Electric Arc-Furnace Regulator.

High electrode-operating speed and close precision of regulation, with absolute freedom from hunting, are the two important features of the electric arc-furnace regulator just placed upon the market by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The ability of this regulator to incorporate high speed with a narrow current zone is due to the fact that the electrode speed tapers all the way from the maximum to zero as the regulated current approaches its normal value. In other words, within cer-



Front View of Regulator Panel.

tain limits the restoring speed is approximately proportional to the amount by which the current in the electrode deviates from normal. This permits the greatest possible electrode speed for a given current variation. This feature is particularly important during the melting-down of cold scrap. For small variations in current the speed is slow enough to prevent continuous breaking of the arc and at the same time, when the solid metal begins to fall into the pools of molten metal under the electrodes, sufficient speed is available to permit the regulator to extricate the electrode before the time relay allows the breaker to trip. When the current is turned onto a furnace charged with cold scrap, it is only necessary to throw the regulator control to the automatic position. Regardless of the position of the electrodes, the regulator will allow each one to run down at full speed until it touches the steel, when complete automatic regulation will commence.



View Showing Wiring and Equipment on Rear of Regulator Panel.

One very important feature of the regulator is its utilization of the arc voltage as well as the arc current to control the motors. This device prevents the electrodes from getting into the steel under automatic regulation. Under-voltage relay trips on the control circuits are unnecessary. With any purely current-actuated device it is impossible to maintain equal arc lengths in furnaces using two or more electrodes, particularly when operating at reduced power.

The voltage coils also make the control of each electrode independent of the others in the furnace. In fact, one electrode may be entirely withdrawn without disturbing any of the others, while in a regulator dependent upon current control exclusively any movement of one of the electrodes causes the elements of all other electrodes to change their position.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

O. K. Giant Battery Co., Gary, Ind., sustained a loss of $200,000 by fire Oct. 6.

Westinghouse Lamp Co., Bloomfield, N. J., is considering plans for extensions in its local plant.

United States Electric Co., New London, Conn., manufacturer of electrical apparatus, has filed notice of dissolution.

Dauphin Electrical Supplies Co., Harrisburg, Pa., has filed notice of increase in its capital to $50,000 for proposed expansion.

Pittsburgh Generator Co., Pittsburgh, Pa., a Delaware corporation, has filed notice of increase in its capital from $50,000 to $300,000.

Holtzer-Cabot Electric Co., Roxbury, Mass., has arranged for the establishment of a local branch at 10 South 18th street, Philadelphia.

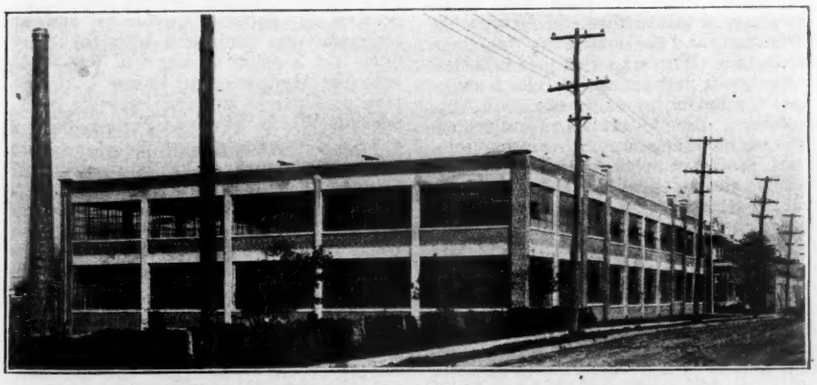
Delta-Star Electric Co., 2437 Fulton street, Chicago, plans to erect a one-story addition to its plant, 67 by 91 ft., at an estimated cost of $19,000.

Westinghouse Electric & Manufacturing Co., Essington, Pa., has broken ground for the erection of a one-story foundry, 160 by 200 ft., to cost about $45,000.

Oakland Electric & Appliance Co. has filed notice of organization to manufacture electrical specialties, with headquarters at 14 Oakland street, Boston. Richard F. Fardy heads the company.

National Conduit & Cable Co., New York City, with plant at Hastings-on-Hudson, N. Y., has discontinued operations temporarily at its brass tube works. It is understood that work will be resumed as soon as conditions warrant.

Bearings Co. of America, Lancaster, Pa., has recently completed a concrete and steel building, illustration of which is shown herewith. With the addition of this new unit to its group of buildings, the company has increased its capacity about 50% in the production of thrust ball bearings and "Star" ball retainers. The new power plant of the company is shown in the background of the picture.



Factory Building Recently Completed for Bearings Co. of America.

Crouse-Hinds Co, Syracuse, N. Y., manufacturer of condulets, etc., has removed its Philadelphia headquarters to the Otis building, where increased space is provided.

J. H. Parker, Inc., and **J. H. Parker & Son, Inc.,** Parkersburg, W. Va., have issued in loose-leaf form a number of sheets containing standard electrical porcelain data.

Brady Electric Manufacturing Co., New Britain, Conn., has filed plans for the erection of a one-story plant addition on Center street, to be equipped as a machine shop.

Exide Battery Co. of Canada, Ltd., 153 Dufferin street, Toronto, Ont., plans to install additional equipment and make alterations to its buildings at an estimated cost of $50,000.

Hobart Brothers Co., Troy, O., has issued a new illustrated folder on its "HB" 32-battery charging outfit, designed for use in battery service stations, garages, etc.

Ideal Gas & Electric Fixture Co., 433 Broadway, New York City, manufacturer of electrical and gas fixtures, has filed notice of increase in capital from $10,000 to $70,000 for proposed expansion..

Van Dorn Electric Tool Co., Cleveland, manufacturer of portable electrically operated drilling, reaming and grinding machines, etc., has issued a circular containing a brief history of the growth of the firm and describing the equipment manufactured together with the various uses for same.

Buffalo Forge Co., Buffalo, N. Y. has issued catalog No. 460, covering its lines of heaters, which was prepared with the view to make it most useful to architects and engineers in figuring the heater requirements for fan heating and ventilating work. It contains various illustrations of heater equipment, also tables that have been elaborated so as to include all the conditions usually met with in practice, which will enable the user to read the values direct. To meet unusual conditions curves have been added giving values for various steam pressures and air velocities.

Electric Storage Battery Co., Philadelphia, has filed plans for additional buildings at its new plant on Rising Sun avenue, to cost about $120,000. Contract for construction has been let to the William Steele & Sons Co., Sixteenth and Arch streets.

Benjamin Electric Manufacturing Co., Chicago, is sending out to the dealers some circular matter relative to the fall drive for the Benjamin No. 92 two-way plug. This sales campaign is being backed up by advertising in many of the leading magazines.

Nordberg Manufacturing Co., designer and builder of steam and oil engines, mine hoists and air compressors, Milwaukee, has completed an addition, 200 by 180 ft., to its main machine shop and bays. An addition to the office building, to provide private offices and more space for the drafting room, is also under way.

General Electric Co., Schenectady, N. Y., has acquired a large interest in the Locke Insulator Co., Victor, N. Y., manufacturer of insulators for high-tension electric service. The Locke company is now building a large plant at Baltimore, which is expected to be ready for occupancy at an early date. The Symington-Hoffman Co., Baltimore, recently acquired control of this company and will be prominently connected with the new management.

Link-Belt Co., 910 South Michigan avenue, Chicago, recently published an illustrated 24-page book covering its traveling water screens. The statement is made that surface condensers are easily clogged up by trash contained in the water supply and are very hard to clean. Clogged condenser tubes mean reduced efficiency of operation and other disadvantages that can be forestalled by the use of traveling screens. This interesting subject is covered fully in Book No. 352, issued by the Link-Belt Co.

Cutler-Hammer Manufacturing Co., Milwaukee, describes and illustrates in a booklet entitled "Charging Equipment for Miners' Lamp Batteries," and known as publication 834, the C-H charging rack, by means of which the handling and arranging of miners' lamp batteries for charging is reduced to the simplest degree. As each rack is a unit in itself a small equipment may be purchased at the start and subsequently extended when more lamps are added. Each unit rack holds ten Edison or lead batteries. To charge his battery the miner merely puts it in that space in the rack assigned to him, in the same manner as putting a book in a bookcase. A rheostat panel is provided with each set of charging racks for adjusting the charging current at the desired value. Reference is also made to C-H charging equipment for charging battery locomotives and trucks. This booklet supersedes the former publication known as booklet "R."

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

V. E. McCAIN, of the Tacoma (Wash.) offices of the Western Electric Co., has been transferred to the Seattle branch as housegoods specialist.

A. H. GUYOT, traffic chief of the American Telephone & Telegraph Co., Louisville, Ky., has been transferred to the Atlanta (Ga.) office of the company.

L. J. CORBETT has accepted a position in the valuation department of the Pacific Gas & Electric Co., San Francisco. He was formerly professor of electrical engineering at the University of Idaho.

DONALD NAPIER, who has been a salesman in the fixture department of the Northwestern Electric Equipment Co., St. Paul, Minn., for several years, has been assigned to sales promotion work.

WILTON BENTLEY, works manager of the Mercury Manufacturing Co. for the past three years, has resigned to assume the duties of manager of the New York office of the K. W. Battery Co of Chicago.

H. A. LEMMON has resigned as sales manager of the Truckee River General Electric Co., Reno, Nev., to accept a position with the Stone & Webster Co., Boston, as head of the personnel department.

F. W. CRAWFORD, president and director of the Ohio Fuel Supply Co., has been elected a director of the Manufacturers' Light & Heat Co., Pittsburgh, succeeding John W. Donnan, who has resigned.

PROF. O. H. LELAND has accepted a position with the J. G. White Engineering Corp., 43 Exchange place, New York City. He was formerly connected with the College of Civil Engineering at Cornell University.

C. E. BLEE has resigned as assistant professor of civil engineering at Stanford University to accept a position as assistant to P. O. Crawford, chief engineer of the California-Oregon Power Co., San Francisco.

F. J. WEIGLE is now connected with the publicity department of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. He was formerly in the advertising department of the Mesta Machine Co., Pittsburgh.

A. H. GRISWOLD has been appointed assistant chief engineer of the International Western Electric Co., New York City. He was formerly plant engineer of the Pacific Telephone & Telegraph Co., San Francisco.

E. A. COUPAL, Buffalo General Electric Co., Buffalo, N. Y., is chairman of a preliminary organization formed by the Buffalo Chamber of Commerce for the purpose of establishing an industrial group to deal with public utilities.

W. L. BIRD, general manager of the Kaministiquia Power Co., Fort William, Ont., has been appointed general manager and treasurer of the Fort William Paper Co., Ltd. He is a former president of the Canadian Electrical Association.

M. L. HASELTON, formerly with the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has accepted a position with the Brooklyn Edison Co., Brooklyn, N. Y, as assistant to G. L. Knight, designing engineer of the company.

CHARLES R. UNDERHILL, whose title was recently changed to consulting electrical engineer, has been connected with the Acme Wire Co., New Haven, Conn., for more than nine years. Although his self-acquired education embraces physics and mathematics, his experience and training have been largely of a thoroughly practical nature.

Charles R. Underhill.

Eight years in the inspection department of the Western Electric Co., New York City; four years as chief electrical engineer of the Varley Duplex Magnet Co.; five years as consulting engineer in New York City, and his connection with a western manufacturer of enameled wire, in charge of the engineering and production, gave him a wide range of experience in the fields of telegraphy, telephony, radio and other signaling, manufacture of enameled wire, coils, and the machinery for their production. This experience is reflected in his books and articles on electromagnets, magnet wires and coils. Mr. Underhill is the inventor of numerous devices, including a radio-printing telegraph system, employing the usual code, and an electric gear shift for automobiles wherein a single electromagnet stores energy in a spring to subsequently shift the gears. During his employment by the Acme Wire Co. he has devoted most of his time and thought to the methods and products of manufacture of the company. Commissioned captain in 1917, he served in the aviation section of the Signal Corps as radio officer in charge of radio tests in flight, and then in the Air Service, on flying status; receiving his honorable discharge at Langley Field in January, 1919. Mr. Underhill is a fellow of the American Institute of Electrical Engineers and also has memberships in other national engineering and scientific societies.

GEORGE L. LOGAN, formerly American consul at Singapore and Penang, Straits Settlements, and for several years secretary of the Philippine Commission at Manila, has been appointed district office manager of the Bureau of Foreign and Domestic Commerce at Boston.

JOHN R. KING has been appointed telephone specialist for the Western Electric Co. in Seattle, Wash., to succeed George Bush, who has resigned to accept a captaincy in the Signal Corps, United States Army. Some years ago Mr. King was connected with the sales department of the Puget Sound Traction, Light & Power Co., Seattle.

R. A. BULL has resigned as vice-president of the Duquesne Steel Foundry Co., Pittsburgh, to accept an appointment as consulting metallurgist for a number of prominent steel foundries grouped for the purpose of developing and perfecting higher standards in the production of steel castings. The members of the group include the Electric Steel Co., Chicago; Fort Pitt Steel Castings Co., McKeesport, Pa.; Isaac G. Johnson Co., Spuyten Duyvel, N. Y.; Lebanon Steel Foundry Co., Lebanon, Pa.; Michigan Steel Castings Co., Detroit, and the Sivyer Steel Castings Co., Milwaukee. Mr. Bull is widely known in the steel castings industry as an authority in metallurgy and foundry practices. He is a member of numerous technical associations and has frequently contributed to the technical press. Since 1911 he has been a director of the American Foundrymen's Association and during 1916 and 1917 served two terms as its president.

OBITUARY.

MAJOR F. C. CONNERY, assistant sales manager of the Canada Wire & Cable Co., Toronto, Ont., died last month. He was a graduate of the Department of Applied Science and Engineering of Toronto University and at one time was connected with the Toronto and Niagara Power Co., and later with the Hydroelectric Power Commission of Ontario and the Pearson Engineering Works of New York City.

JOHN DALE, one of the pioneers in the manufacture of artistic electrical fixtures, died Oct. 11. He began as a journeyman electrician about 30 years ago and developed a number of ideas in the way of electrical fixtures for office buildings and private residences. In 1913 he reorganized his business to manufacture for the retail trade and took the premises at 107 West 13th street, New York City, where the factory and showrooms of the John Dale Co. are now located. He is survived by his wife.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Kittery, Me. — The Consolidated Construction, Power & Mining Co., recently organized with a capital of $1,000,000, is planning the construction of a power plant in connection with its mining and quarrying operations in this section. John O'Donnell is president, and Oscar H. Nelson, treasurer.

Boston, Mass. — The Thomas G. Plant Co. has filed plans for extensions and improvements in the power plant at its shoe factory at Jamaica Plains to cost about $50,000.

New Bedford, Mass.—Electrical and mechanical equipment will be installed in the addition to be erected at the plant of the Whitman Mills Corp.

Norwood, Mass. — The Holliston Mills have awarded a contract to C. A. Batson, Brockton, Mass., for the construction of additions to its textile plant to include a one-story power house, 50 by 70 ft.

Worcester, Mass.—The F. L. Horton Corp. has filed plans for improvements in the power house at its works on James street.

Bridgeport, Conn. — The Seimon Hard Rubber Co. has filed plans for the erection of a one-story power house at its plant on Edgewood street.

Hartford, Conn.—Electric equipment will be installed in the new municipal machine shop to be constructed by the city for the fire department on John street, 50 by 125 ft.

Buffalo, N. Y. — The Buffalo City Service Corp. has been incorporated with a capital stock of $10,000 to operate a local light and power system. The incorporators are R. C. Davidson, G. W. Wheeler and T. C. Burns.

Buffalo, N. Y.—The Phoenix Beverage Co., 835 Washington street, will erect a one-story addition to its power house, to cost about $15,000.

Elmhurst, L. I., N. Y.—In connection with its new plant on a local site, the Improved Office Partition Co. will operate an isolated power plant for general works service. The mill has a capacity of 3,000,000 sq. ft. of material per annum, and the majority of the equipment will be electrically operated.

Smyrna, N. Y.—The Smyrna Electric Light Co. has been incorporated with a capital of $25,000 to operate a local electric light and power system. The incorporators are J., E. and L. J. Nelson, Shelburne, N. Y.

Watertown, N. Y.—The Black River Valley Power Co. has been incorporated with a capital of $10,000 to operate a light and power system in Jefferson county. The incorporators are D. M. Anderson, F. L. Carlisle and F. A. Empsall.

Watertown, N. Y.—The Jefferson Power Co., recently organized with a capital of $50,000, will operate a light and power system in this section. The company is headed by D. M. Anderson and E. B. Martin.

Bloomfield, N. J. — Considerable electrically operated equipment will be installed by the Klaxon Co., Wright street, Newark, N. J., in connection with the removal of its plant here, to occupy two of the buildings at the former plant of the International Arms & Fuse Co.

Camden, N. J.—The MacAndrews & Forbes Co., Third and Jefferson streets, has filed plans for extensions and improvements in its power plant, to cost about $150,000.

Kearny, N. J.—The Ford Motor Co. has completed the erection of a power plant at its local assembling works, replacing service heretofore supplied by a temporary plant.

Matawan, N. J.—The borough council has awarded a three-year street-lighting contract to the Monmouth Lighting Co., Freehold.

Maurer, N. J.—In connection with the rebuilding of its local asphalt works, the Barber Asphalt Paving Co., 233 Broadway, New York City, will build a power plant for general operation, replacing a former structure used for this purpose. Electric traveling cranes and other material-handling equipment will be installed.

Tuckerton, N. J.—The Atlantic City Electric Co. has made application for permission to construct a power line for service to the radio station here, to be operated in the future by the United States Radio Supply Co. In connection with the line construction, the municipal officials are negotiating with the company for the installation of a local commercial system, to include street-lighting and general service.

West Orange, N. J. — Ground has been broken for the erection of a power plant at the works of Thomas A. Edison, Inc., estimated to cost $63,000.

Dover, Del.—The Natrona Power Co., Casper, Wyo., a Delaware corporation, has filed notice of increase in its capital from $500,000 to $1,000,000.

Allentown, Pa.—The city council is arranging specifications for a new street-lighting contract and will soon call for bids. A number of changes is planned in the system, including the relocation of certain lamps. Heretofore the service has been furnished by the Pennsylvania Light & Power Co. The new contract will cover either one, three or five years, this still to be decided.

Bakerstown, Pa.—The Pittsburgh Cut Flower Co., 116 Seventh avenue, has had plans prepared for the erection of a one-story power house, 42 by 75 ft., at its local works.

Lancaster, Pa. — The Edison Electric Co., Lancaster, and the Harrisburg Light & Power Co., have preliminary plans under way for the joint construction of a hydroelectric power plant on the Susquehanna river, Conoy township, Lancaster county. The proposed station will have a generating capacity of about 100,000 kw., and is estimated to cost $3,000,000. An operating company will be formed to carry out the project, headed by officials of the two companies. It is understood that the Susquehanna Water Power Co., now operating a plant at Holtwood, is interested in the new plant.

Lansdale, Pa.—The borough council has arranged for a bond issue of $50,000, to be used for the installation of new equipment at the municipal power plant, for increased capacity as well as for emergency service. A holding company has been organized, headed by prominent industrial interests, and the bonds will be disposed of locally. Bids for the new machinery will be asked at an early date.

Mt. Holly, Pa.—The Kraybill Light, Heat & Power Co. has received permission from the Public Service Commission to sell its property at Leidigh Mill, a former source of water supply for the utility.

New Castle, Pa. — The Standard Electric Co. has been incorporated with a capital of $5000 to operate a local electric lighting system. William A. Moore, New Castle, is treasurer of the company.

Philadelphia, Pa.—The department of public works, bureau of water, will soon call for bids for extensions and improvements in the pumping plant at Queens Lane, used in connection with the municipal waterworks.

Scranton, Pa.—The Scranton Electric Co. has arranged for a bond issue of $1,000,000, the proceeds to be used in part for proposed extensions and improvements in its electric power plant, transmission and distributing system. The company is furnishing electric light and power service in 28 municipalities in this district, with an estimated population of 330,000. Energy is also supplied to the Scranton Railways Co. for the operation of its system, totaling about 100 miles. R. E. Breed is president.

Baltimore, Md.—The Consolidated Gas, Electric Light & Power Co., Lexington building, has arranged for the immediate removal of buildings now located at 501-29 East Madison street, clearing the site for the erection of its proposed electric power plant at this location. The company has leased the five-story building at 18 South Howard street and will use the structure in connection with its fixture business.

Baltimore, Md.—Electrical and mechanical equipment and refrigerating apparatus will be installed by the American Ice Co., Calvert building, at its proposed plant on Montford ave-

nue, near Chase street, 33 by 82 ft., estimated to cost $200,000.

Hagerstown, Md.—The Chesapeake & Potomac Telephone Co. has commenced the construction of a pole line and system from Shepherdstown to Sharpsburg. The line will replace the present wires used on the poles of the Western Union Telegraph Co. The Potomac river will be spanned with a cable 700 ft. in length.

Oakland, Md.—The city council is arranging a bond issue of $50,000 for the establishment of a municipal electric power plant. It is proposed to purchase the present station of the Oakland Electric Co. for a consideration of about $11,000, using the balance of the fund for rebuilding the plant and installing new equipment.

Salisbury, Md.—Electrical and mechanical equipment, with refrigerating apparatus will be installed in the local plant to be erected by the William F. Messick Ice Co., recently organized with a capital of $150,000.

Washington, D. C. — Electrical equipment and ice-making machinery, etc., will be installed in the plant to be erected by the Washington Ice Manufacturing Co., at 1233-35 Twenty-third street. The plant is estimated to cost $90,000.

Fairfax, Va.—The city commission is interested in a proposition to install a local electric light and power system.

Martinsburg, W. Va.—The Cumberland Valley Telephone Co. has presented a petition to the city council, asking permission to sell its plant and system to the Chesapeake & Potomac Telephone Co. The change will be made within one year. The company is understood to be arranging for the disposition of all of its property in this section, including Williamsport and Hagerstown, Md. The city council at the latter place has granted the company permission to make the sale.

New Martinsville, W. Va.—Electrical and mechanical equipment will be installed in the proposed plant of the New Martinsville Glass Manufacturing Co., to replace the works destroyed by fire on Sept. 28, with loss estimated at $60,000.

Princeton, W. Va.—The Princeton Power Co. has increased its capital to $300,000 for proposed plant and line extensions.

Belmont, N. C.—Considerable electrical equipment, including motors, etc., will be installed in the proposed local mill of the Sterling Spinning Co. All equipment in the mill will be electrically driven. R. C. Biberstein, Charlotte, N. C., is engineer for the project.

New Holland, N. C. — The North Carolina Farms Co., operated by Benham & Richard, Columbus, O., is planning the installation of an electric lighting system in connection with property development in this section.

Wilson, N. C.—The city will install an electric light system, for which bonds to the amount of $110,000 have been voted. Additional equipment will be purchased. Address the mayor.

Winston-Salem, N. C.—The Electric Light & Power Corp. has filed notice of increase in its capital to $500,000 for proposed expansion.

Lamar, S. C.—The Lamar Light & Power Co. has secured a franchise for local electric light and power service.

Jacksonville, Fla. — The city commission has plans under way for the construction of a 13,000-volt line to the plant of the Federal Ice Co.

NORTH CENTRAL STATES.

Ashtabula, O.—An election will be held Nov. 2 to vote on the question of issuing $1,000,000 electric power bonds.

Marion, O.—The city council has directed the Delaware & Marion Electric Co. to install 21 additional lamps, Address Ralph Corry, city clerk.

Anderson, Ind. — The city has awarded contract to Eshelman & Sons for the construction of a building at the municipal light plant.

Clarks Hill, Ind.—Plans are under way for the erection of a power house and the wiring of streets and residences. Address village clerk.

Columbia City, Ind. — Plans have been prepared by Charles Brossman, engineer, 1508 Merchants Bank building, Indianapolis, for the erection of a $40,000 electric light plant for the city. Address city clerk.

Crothersville, Ind.—The town having voted sufficient funds to purchase the local plant, it will be dismantled and energy purchased from the Interstate Public Service Co. Address secretary of the board of public affairs.

Dublin, Ind.—Bids were opened recently for lighting the village. Energy will be furnished by the Terre Haute, Indianapolis & Eastern Traction Co. Address R. M. Cass, electrical engineer.

Frankfort, Ind.—The Central Union Telephone Co. will erect a $30,000 telephone exchange, plans for which have been prepared by W. S. Hays, architect, 212 West Washington street, Chicago.

Georgetown, Ind.—Plans are being considered for installing a lighting plant in this village. Bids will be asked for in a short time for dynamos, engine, switchboard and line material.

Huntingburg, Ind.—Another unit is being installed at the city power plant to take care of the increased load and also furnish light and power to the adjacent villages of Holland and Dale. Plans are under way to run transmission lines this fall to these towns. Address Leo Grewe, superintendent.

Newtown, Ind. — The local power plant will be for sale in the near future, and a transmission line erected to the corporation line at Attica, thereby giving not only a 24-hour service in Newtown, but furnishing electric service to the farmers along the way. Address W. V. Stanfield, superintendent.

West Lebanon, Ind. — A transmission line is being erected to Attica and motors will be wanted for mills and farmers. Address Ike Hall, manager.

Roachdale, Ind.—The electric light plant at Ladoga, Ind., has been purchased by the Roachdale Electric Co. and will be dismantled, and a transmission line will be erected from Roachdale to furnish energy to the town and farmers along the way. Address John Couchman, manager.

Alvin, Ill.—The Alvin Grain & Electric Co. is erecting a transmission line from Bismarck, Ill., to State Line, Ind., which will furnish current to 50 or more farmers along the way.

Beecher, Ill. — The local lighting plant, having been sold to the Momence Utilities Co. will be dismantled, and a transmission line will be erected from Momence.

Middletown, Ill.—The city has voted $8000 for electric lights.

Waynesville, Ill. — A direct-current lighting plant is being installed by the municipality. Address J. E. Buck, village clerk.

Lonesdale, Minn.—The Consumers Power Co. of Elma, Ia., will extend its line here at an estimated cost of $6000.

Owatonna, Minn.—The Owatonna city council has authorized a special committee to draw up a resolution proposing a bond issue which will empower the city to buy or contract for a municipal lighting, power, heating and gas plant. The issue will be submitted to a vote some time after the November election.

Thief River Falls, Minn.—The city will install new cables for "white way" lighting system. Address A. H. Akre, city clerk.

Two Harbors, Minn.—The Duluth & Iron Range Railroad Co. will install a switchboard and construct lead-covered aerial cable from First to Eleventh avenue. Rural lines to the Silver Creek district and to St. Louis county will also be built. The estimated cost is $10,000.

Clinton, Ia. — The Clinton Gas & Electric Co. contemplates the installation of additional turbines to develop 3500 kw. capacity.

Farlin, Ia. — The Farlin Light & Power Co. has been organized with a capital of $10,000. Address W. J. Banning, secretary.

Greenfield, Ia.—An election will be held shortly to vote on the question of issuing bonds to enlarge the electric lighting plant.

Lewiston, Neb.—An election will be held soon to vote on the question of issuing $42,000 in bonds for the installation of an electric light plant.

SOUTH CENTRAL STATES.

Whitesburg, Ky.—W. C. Daniel & Son have plans under way for the erection of a local power plant to be steam operated. It will be used for industrial and commercial service. The installation will comprise electric generator, switchboard and auxiliary apparatus.

Williamsburg, Ky.—The Williamsburg Electric Co. has been incorporated with a capital of $40,000 by T. B. Mahan and others. The company is erecting a power house, 30 by 60 ft., and plans to install electrical equipment.

Crowley City, La.—The city will construct light, power, water and gas plants. Bonds to the amount of $500,000 have been voted for this purpose. Address the mayor.

Sand Springs, Okla. — The Sand Springs Light, Heat & Power Co. will build ten miles of high-voltage trans-

mission line on the Arkansas river from Sand Springs to Tulsa, Okla.

Owasso, Okla.—The Owasso Power & Light Co., has been incorporated with a capital of $10,000, the incorporators being E. L. Mayfield and others.

Austin, Tex.—Considerable electrical and mechanical equipment will be installed in the plant to be erected by the Woodward Manufacturing Co., San Antonio, Tex., at the former local government works, for the manufacture of automobiles and parts. D. J. Woodward is president.

Moran, Tex.—The Albany Light & Stone Quarry Co. will construct a high-power electric transmission line from Albany; also install a water works and dam Deep creek for water reserve. The estimated cost of the project is $90,000.

WESTERN STATES.

Great Falls, Mont.—The Montana Power Co. will install a wireless telephone system between its 11 plants in the state.

Logan, Utah—The city commission is going over plans for an electric light plant in Logan canyon and the pipe line which carries the water to the plant. At present the city is purchasing energy from the Utah Power & Light Co. Address Mayor Howell.

Stratford, Cal. — The commercial club is making arrangements to install lights, water and other conveniences in East park.

Ventura, Cal. — The Sespe Power Corp., which plans the construction of five hydroelectric power units on the Sespe river, Ventura county, has been authorized by the California Railroad Commission to issue $1,000,000 of its common stock to secure funds for carrying out its development program.

Wrangell, Alaska—W. D. Grant, D. Y. Frant, Donald Sinclair and S. C. Schurick have applied to the Federal Power Commission for a permit to develop hydroelectric power on Crittenden and Mill creeks and on Virginia lake and the two branches of Bradfield river, all in the vicinity of Wrangell. It is proposed to use the power for mining and milling operations.

CANADA.

Cochrane, Ont.—The town council plans to buy the lighting system of the Northern Ontario Light & Power Co. and the telephone system of the Cochrane Telephone Co.

Montreal, Que.—The administrative commission has approved the signing of a contract with the Montreal Light, Heat & Power Co. for supplying electric energy to the amount of 4000 hp. for a period of not less than 25 years, which will provide for the operation of the new electric pumping plant at the lower level station.

INCORPORATIONS.

Seattle, Wash.—The Electric Specialty Manufacturing Co., capital $100,000. Incorporators: H. R. Mitchell and others.

Toronto, Can.—The Willard Storage Battery Co., Ltd. Capital $200,000. To manufacture storage batteries, supplies, electrical goods, etc. Incorporators: John T. Foster and others.

Birmingham, Ala.—Jones Valley Telephone Co. Capital $2500. Incorporators: B. M. Allen, president, and others.

Red Forks, Okla.—The Red Forks Telephone Co. Capital $10,000. Incorporators: J. N. Clark and others.

Catlettsburg, Ky.—The People's Telephone System. Capital, $20,000. Incorporators: L. T. Everett and others.

Boston, Mass.—Wonderlight, Inc., Capital $50,000. To manufacture electric lamps. Incorporators: Lawrence E. Johnson, Willard N. Morrison, Melrose, Mass.; and G. Ivar Johnson, Malden, Mass.

Schenectady, N. Y.—Sterling Storage Battery Co. Capital $10,000. To manufacture batteries and other electrical products. Incorporators: S. R. van Patten, M. J. Vandermark, and C. E. School, Schenectady.

Jamestown, N. Y.—Lindstrom-Anderson Electric Co. Capital $10,000. To manufacture electrical products. Incorporators: L. A. and E. C. Lindstrom, and E. J. Anderson, Jamestown.

Atlantic City, N. J.—United States Radio Supply Co. Capital $10,000. To manufacture electrical and wireless equipment. Incorporators: C. E. Torrey, John P. Tompkins and R. E. Swift.

Philadelphia, Pa.—Gophin State Electric Co. Capital $60,000. To operate as electrical engineer, and manufacture electrical products. Incorporators: G. Morris Taylor, Albert W. Bull, and Clyde R. Thackery, Philadelphia.

Hartford, Conn.—Jensen Battery Manufacturing Co. Capital $50,000. To manufacture batteries and other electrical equipment. Incorporators: M., C. C. and G. C. Jensen, all of Hartford.

New York, N. Y.—Pall Mall Electric Co. Capital $100,000. To manufacture electrical equipment. Incorporators: W. M. and J. M. Jenkins, and G. L. Burkle, Yonkers.

New York, N. Y.—Illuminating Sales Co. Capital $25,000. To manufacture electric fixtures and kindred products. Incorporators: S., J., and H. Garfunkel, 47 West 46th street.

West New York, N. J.—The Daylight Lamp Works, Inc. Capital, $25,000. To manufacture electric lamps and other electrical specialties. Incorporators: S. Englowitz, T. Ungerer, and Samuel Pollock, all of West New York.

Hoboken, N. J.—The Forshee-Moller Corp. Capital, $20,000. To manufacture electrical appliances. Incorporators: A. T. Rook, Herbert A. Cone and James K. Forshee, all of Hoboken.

Pittsburgh, Pa. — The American Alarm Sales Co., Inc. Capital, $75,000. To manufacture electrically operated alarm systems. Incorporators: J. M. Quinn, W. H. Marshall and Frank McCloskey, all of Pittsburgh.

Baltimore, Md.—The Gibson & Kirk Co. Capital, $100,000. To engage as electrical engineers and manufacture electrical products Incorporators: Irvin C. Griggs, M. H. White, and William C. Ludwig, 211 Key Highway.

Baltimore, Md.—The Home Lighting Co. Capital $20,000. To manufacture lighting fixtures at 616 East Baltimore street. Incorporators: Israel Hoffman, Maurice Blumberg and Joseph Vigman.

Frederick, Md.—Price Brothers, Inc. Capital $100,000. To manufacture wireless equipment for land and naval service. Incorporators: Joseph B. Price, A. A. Nichdemus and Osborne I. Price.

Dayton, O.—Apple Electric Manufacturing Co. Capital $500,000. To manufacture electric motors and dynamos. Incorporators: Vincent G. Apple and others.

Lynn, Mass.—The Congress Electric Co. Capital $100,000. To manufacture electrical goods. Incorporators: Charles H. Gilmore, George O. Willey, Martin F. O'Mealley and J. Ralph Wellman, Melrose, Mass.

Fond du Lac, Wis.—The Gravity Power Motor Co. Capital $10,000. Incorporators: Fred Klassen, George H. Higlen and Louis Higlen.

FOREIGN TRADE.

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Supplies (33,725) — An agency is desired by a merchant in Italy for the sale of electrical supplies.

Electric Lamps (33,564)—An importer in Italy desires to purchase a large quantity of small electric lamps from 105 to 110 volts with metallic filaments, and requests quotations c. i. f. Italian port, stating quality, etc. Correspondence may be in Italian or French. No reference offered.

Wireless Sets (33,721)—The government of one of the South American republics desires to purchase about 20 small inland wireless sets. The type and size of the plants desired are about 10 kw., with about a land radius of 150 miles under all conditions. Prices should include the complete set ready for installation or actually installed, the latter preferred.

Electrical Appliances, etc. (33,790)—Bids are desired by a municipality in the Azores for the construction and maintenance of a hydroelectric plant to supply power for public and private lighting for two cities. Interested firms should submit proposals for the installation and supply of all electrical and mechanical appliances, machinery, turbines, etc. The preliminary work is about completed and only lacks the installation of the machinery and appliances indicated in the specifications, a copy of which, together with blank bids, in Portuguese, were received and may be examined at the bureau or its district offices. (Refer to file No. 15,261.) Correspondence may be in English.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Gross Gains Shown by Public Service Co. of Northern Illinois.

In connection with the public offering of $1,000,000 Public Service Co. of Northern Illinois 10-year 8% collateral gold notes, series "A," Samuel Insull, president of the company, made the following statement: "Based upon the results for the first eight months of the current year and the increased rates made effective Aug. 1, 1920, it is conservatively estimated that operating revenues for the year ending Dec. 31, 1920, will approximate $11,142,146, as compared with $9,086,226 for the year ended Dec. 31, 1919. It is estimated that net earnings for 1920 will be about the same as reported for the year 1919."

United Light & Railways Co. and Subsidiaries.

The report for the twelve months ending Aug. 31, 1920, and comparisons for the same period the previous year shows the following:

	1920.	1919.
Gross earnings	$11,421,633	$9,815,053
Operating expenses (including maintenance, general and income taxes)	8,207,176	6,929,025
Net earnings	3,214,456	2,886,017
Interest and dividends subject to correction	889,244	902,532
Balance	2,325,212	1,984,385
Interest, United Light & Railway Co.	944,065	874,903
Balance for dividends	1,381,146	1,109,481
Dividends for preferred stock	603,258	606,200
Surplus earnings	777,888	502,281

Commonwealth Power, Railway & Light Co. and Subsidiaries.

	1920.	1919.
August gross	$2,627,694	$2,142,021
Net earnings	789,650	827,614
Surplus after fixed charges	43,269	146,602
Deficit after preferred dividends	46,495	*56,837
Twelve months' gross	29,648,630	24,417,558
Net earnings	10,785,584	9,956,321
Surplus after fixed charges	2,169,479	1,865,311
Balance after preferred dividends	1,092,299	788,131

*Surplus.

Option on Stock of Western Power Co. of Canada.

It is reported that more than the required 56% of the common stock of the Western Power Co. of Canada has been deposited under the plan by which an option is given to Canadian interests to purchase the company's common stock at $35.10 a share and the preferred at $70 a share. Deposits of stock will be received up to Nov. 1.

Union Electric Light & Power Co. to Sell Stock.

Application has been made by the Union Electric Light & Power Co., St. Louis, to the State Public Service Commission of Missouri for authority to sell $1,000,000 of its preferred stock to reimburse the company for expenditures in the way of improvements. The stock bears 7% interest.

American Water Works & Electric Co. and Subsidiaries.

For the year ended June 30, 1920, the earnings of waterworks properties were $4,876,977, decrease $134,339; earnings of West Penn properties (power and railways), $12,327,192, increase $1,964,709; gross earnings, $17,204,169, increase $1,830,370; net earnings, $1,322,254, increase $58,301; interest on collateral trust bonds, $799,698, increase $9196; other interest, $33,910, decrease $4431; total interest deductions, $833,608, increase $4765; net income, $488,646, increase $53,536.

Offering of Nebraska Power Co. Gold Bonds.

The Harris Trust and Savings Bank, Chicago, and Coffin & Burr are offering $1,600,000 Nebraska Power Co. first mortgage 6% gold bonds due June 1, 1949, at 84.5 and interest, yielding about 7.3%.

Tennessee Railway, Light & Power Co. and Subsidiaries.

	1920.	1919.
July gross	$ 513,040	$ 425,610
Net after taxes	194,992	165,595
12 months' gross	5,852,178	5,472,178
Net after taxes	2,177,329	2,230,428

United Gas & Electric Corp.

	1920.	1919.
August gross	$ 979,824	$ 813,948
Net after taxes	287,505	310,098
Total income	290,593	312,068
Surplus after charges	102,464	132,331
12 months' gross	11,784,641	9,850,960
Net after taxes	3,981,948	3,238,195
Total income	4,032,027	3,269,312
Surplus after charges	1,558,175	1,118,402

California Railway & Power Co.

The California Railway & Power Co. of San Francisco reports for the year ended June 30, 1920, a net loss after expenses, taxes, etc., of $23,838, compared with $28,528 for the previous year. The income account for the year ended June 30, 1920, compares as follows:

	1920.	1919.
Total income	$ 3,457	$ 131
Expenses, taxes, etc.	27,295	28,659
Net loss	23,838	28,528
Previous deficit	34,026	5 498
Total deficit	57,864	34,026
Dividend on prior preferred stock	.....	.....
Profit and loss deficit	57,864	34,026

National Telephone & Electric Co. to Issue Gold Notes.

A $200,000 issue of 7% mortgage gold notes of the National Telephone & Electric Co., with George G. Argo, Clinton, Ill., as trustee, has been authorized by the Illinois Public Utilities Commission. Three-year 7% convertible notes to the amount of $175,000 were also authorized.

Columbia Gas & Electric Co.

The Columbia Gas & Electric Co. and subsidiaries for August and the eight months ended Aug. 31 report earnings as follows:

	1920.	1919.
August gross	$1,023,278	$ 804,071
Net after taxes	446,862	102,581
Surplus after charges	243,046	132,296
Eight months' gross	9,503,915	7,709,114
Net after taxes	4,802,639	3,801,034
Surplus after charges	3,215,744	2,059,586

Western States Gas & Electric Co.

The combined earnings of the Western States Gas & Electric Co. for the 12 months ending Aug. 31, 1920, compared with the corresponding period last year are as follows:

	1920.	1919.
August gross earnings	$ 185,818	$ 154,315
Net earnings	61,171	58,571
For 12 months ending Aug. 31, 1920:		
Gross earnings	2,134,398	1,788,412
Net earnings	840,437	732,370

Dividends.

The Ottumwa Railway & Light Co. has declared its regular quarterly dividend of 1.75% on the preferred stock, payable Oct. 15 to stockholders of record Sept. 30.

The Western States Gas & Electric Co. has declared its regular quarterly dividend of $1.75% on the preferred stock, payable Oct. 15 to stockholders of record Sept. 20.

The West Penn Power Co. has declared its regular quarterly dividend of 1.75% on the preferred stock, payable Nov. 1 to stockholders of record Oct. 21.

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Oct. 5.	Bid Oct. 12.
Adirondack Electric Power of Glens Falls, common	6	14	14
Adirondack Electric Power of Glens Falls, preferred	6	70	70
American Gas & Electric of New York, common	10+extra	91	97
American Gas & Electric of New York, preferred	6	36	37
American Light & Traction of New York, common	..	127	110
American Light & Traction of New York, preferred	6	82	82
American Power & Light of New York, common	4	45	45
American Power Light of New York, preferred	6	68	67
American Public Utilities of Grand Rapids, common	..	6	7
American Public Utilities of Grand Rapids, preferred	7	14	16
American Telephone & Telegraph of New York	..	99	99
American Water Works & Elec. of New York, common	..	2½	7
American Water Works & Elec. of New York, particip	7	4	25
American Water Works & Elec. of New York, 1st preferred	..	39	45
Appalachian Power, common	..	1	3
Appalachian Power, preferred	7	14	15
Cities Service of New York, common	+extra	296	297
Cities Service of New York, preferred	6	66	65½
Commonwealth Edison of Chicago	8	100	99
Comm. Power, Railway & Light of Jackson, common	..	16	17
Comm. Power, Railway & Light of Jackson, preferred	6	36	39
Federal Light & Traction of New York, common	..	6	7
Federal Light & Traction of New York, preferred	..	41	43
Northern States Power of Chicago, common	..	30½	35
Northern States Power of Chicago, preferred	ex.div.7	76	79
Pacific Gas & Electric of San Francisco, common	..	48	49
Public Service of Northern Illinois, Chicago, common	7	64	64
Public Service of Northern Illinois, Chicago, preferred	6	84	85
Standard Gas & Electric of Chicago, common	..	14	15
Standard Gas & Electric of Chicago, preferred	8	35	36
Tennessee Railway, Light & Power of Chattanooga, common	..	1	1½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	2½	3½
Western Power of San Francisco, common	..	18	21
Western Union Telegraph of New York	extra	88	89
Industrials—			
Electric Storage Battery of Philaedlphia, common	4	118	120
General Electric of Schenectady	8	140	141
Westinghouse Electric & Mfg. of Pittsburgh, common	7	49	49